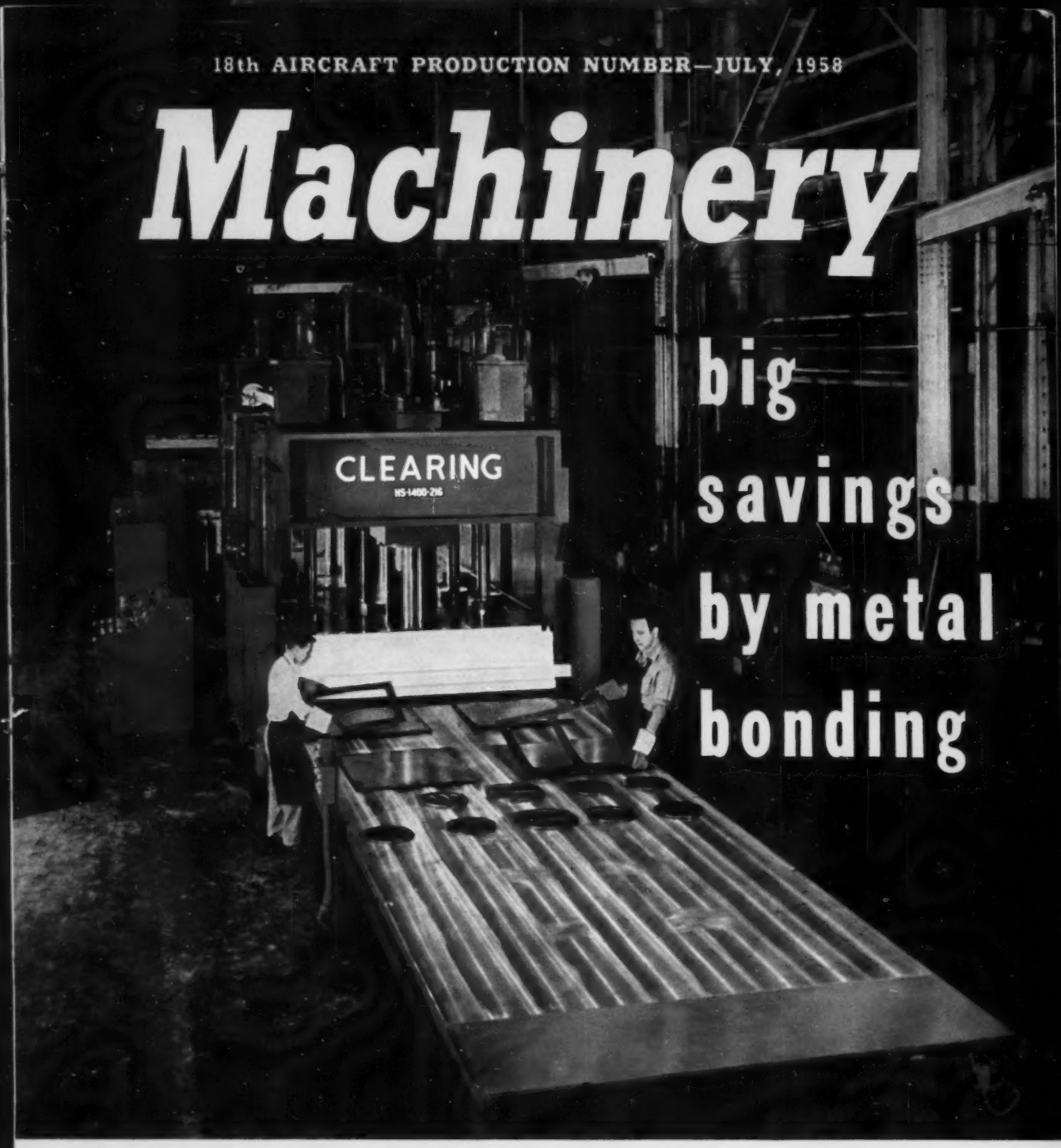
18th AIRCRAFT PRODUCTION NUMBER—JULY, 1958

# Machinery

## big savings by metal bonding




Clearing Machine Corporation has provided Convair (San Diego), a Division of General Dynamics Corporation, with a new press design concept for reducing production costs of air frame structures. Light gauge metal parts which have been preblanked are bonded together under heat and pressure on this 1400 ton hydraulic press. In this way a heavy gauge structural member is produced accurately and inexpensively. The press has a large working area, 18 feet by 7 feet, with 18 foot loading tables at each end.

Convair-San Diego wanted zero deflection in the press in order to achieve a perfect bond. The unusual way in which Clearing engineers met this challenge will be interesting to you. Write for details.

CLEARING PRESSES

*the way to efficient mass production*

CLEARING MACHINE CORPORATION
*division of* U. S. INDUSTRIES, INC.

6499 W. 65th Street • Chicago 38, Illinois/Hamilton Plant, Hamilton, Ohio

# it's mainly a matter of TIMING!

## *Knowing WHEN to replace a machine saved one manufacturer $16,794 a year*

TAKE ANY machine in your plant. You know that some day it will have to be replaced. But *when?* That is the big question. And wrong answers probably cost American Industry millions of dollars every year.

For any machine, there is one optimum replacement time—the time when it can be replaced with a new one at *lowest overall cost*. And it can't be determined by haphazard methods. Guesswork, intuition or rule-of-thumb computations will be wrong most of the time. And even some obsolescence formulas are not above suspicion. But you can put a dollar sign on every variable involved, and come up with a precise figure that will mean a major saving in production cost and capital investment.

Heald sales engineers are well experienced in making obsolescence studies to determine when a machine should be replaced. Sometimes it is found that replacement is overdue. And often it can be shown that next year or the year after would be better for the customer. If you would like help in planning your replacement program, or want to confirm your estimates for a particular machine, just call in your Heald engineer. Similar studies have pointed the way to many important savings.

***For Example:*** A manufacturer of aircraft instruments had been using a 5-year-old precision lathe to perform boring, turning and facing operations on instrument cases. But when this was replaced with a new Heald Model 0 Unit-Type Bore-Matic like that shown at the right, operating costs for the same production were immediately reduced by over 78%. In addition, the elimination of a separate burring operation and reduced assembly time made further important savings, as indicated by the cost analysis below.

| | Old Machine | New Machine |
|---|---|---|
| Parts per hour | 4.3 | 20 |
| Parts per year (Req'd. Prod.) | 10,000 | 10,000 |
| Direct and Indirect Labor, per year | $20,349 | $ 6,055 |
| Scrap Losses, per year | $ 500 | $ 300 |
| Annual Maintenance Cost | $ 600 | $ 300 |
| Annual Operating Cost | $21,449 | $ 6,655 |
| Basic Annual Saving, New Machine | | $14,794 |
| Additional Saving from elimination of separate operation | | $ 500 |
| Additional Saving from reduced assembly time | | $ 1,500 |
| Total Saving Per Year | | $16,794 |
| Return on Investment for New Machine | | 84% |

*YOU pay for obsolescence. Replacement pays for itself!*

**THE HEALD MACHINE COMPANY**

Subsidiary of The Cincinnati Milling Machine Co.

**Worcester 6, Massachusetts**

Chicago • Cleveland • Dayton • Detroit • Indianapolis • New York

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# Machinery

**JULY 1958** **VOL. 64 NO. 11**

*THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS*

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# expensive part thread-rolled and burnished

## . . . with no spoilage

Specifications required that threads be rolled and thread relief burnished after heat treat on this highly critical, highly stressed aircraft jet engine mounting made by Liston Grinding Company, Tonawanda, New York.

Both operations were performed between centers on the same LANHYROL Machine with the same work-holding fixture. The plastic deformation and cold working of the thread rolling process vastly improved the tensile strength and fatigue resistant properties of the part. The material was 4340 steel at a minimum hardness of 40 Rockwell "C" to assure a tensile strength of 180,000 to 200,000 PSI.

Prior to the LANHYROL operations, each part contained many hours of manufacturing time. Because of this accumulated cost, it was essential that burnishing and rolling be accomplished with minimum scrap. Of the entire lot of parts rolled to date, not one has been spoiled in either rolling operation, including those used in setting up the machine.

**Neck diameter and radius adjacent to the thread had to be burnished**

The roll-burnishing operation (figures 2 & 3) preceded the threading operation and was for the purpose of increasing the fatigue resistant properties of the material by cold working plus the reduction of any stress-raising grinding tool marks. The surface burnished had to include the entire .130 radius, the .6954 neck diameter and the .02 radius adjacent to the thread. First, the surfaces were ground to a surface finish approximating 20 micro-inches before roll-burnishing. Then roll-burnishing was performed at a roll-pressure of 25,000 pounds to result to a 4/6 micro-inch finish. The workpiece ran at a speed of 480 RPM and the dies were in contact with the workpiece for 1.5 seconds.

**All threads produced with a pitch diameter variation of less than .0005"**

After roll-burnishing, the $\frac{3}{4}$" — 16 UNF—1.03" long threads were rolled (figures

*figure 1*

Jet Engine Mounting—burnished and thread rolled by the LANHYROL Machine

526C

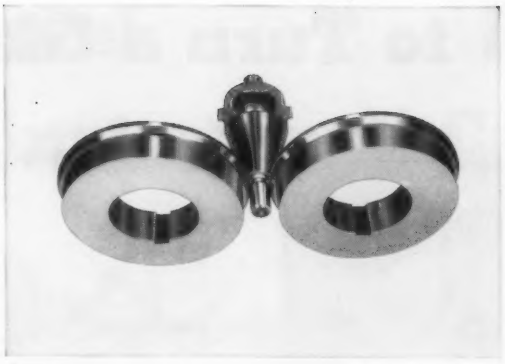


figure 2

Simulated machine set-up for roll burnishing

4 & 5) at a workpiece speed of 1320 RPM. The thread rolling dies were in contact with the workpiece for only .24 of a second. *All threads were produced to near-perfect concentricity with a pitch diameter variation of less than .0005".*

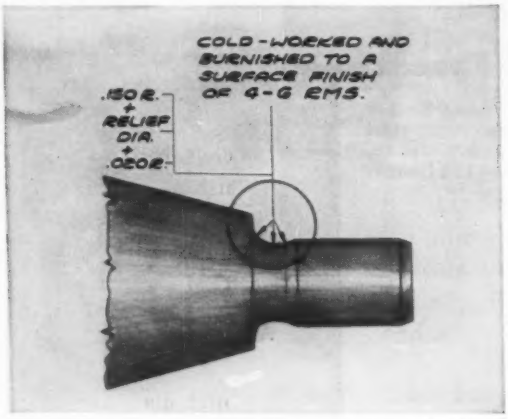



figure 3

Drawing illustrating roll-burnishing operation

**High Production • Accuracy**
**Wide Range • Flexibility**

This LANHYROL operation is but one of the many producing outstanding results.

**LANDIS *Machine* COMPANY**
WAYNESBORO • PENNSYLVANIA
THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

Production data from these installations prove the unequalled productivity and dependability of this versatile machine.

The LANHYROL Thread Rolling Machine produces strong, accurate threads of excel-

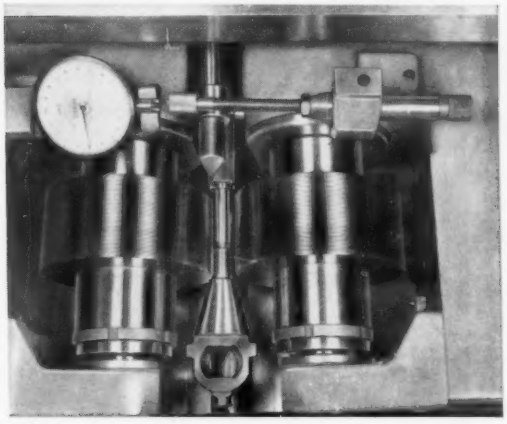


figure 4

Machine set-up for thread rolling

lent finish by any one of four rolling methods —Thrufeed, Infeed, Continuous or Reciprocal. It will thread all diameters from "0" to 3", producing left and right hand threads of all types, including UNC, UNF, Acme, worm and many special forms.

Additional information on request — please send specifications and ask for Bulletin E-60.

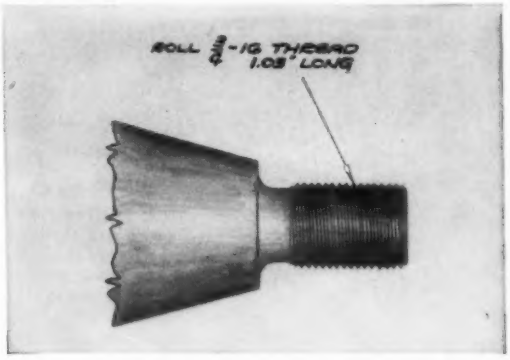
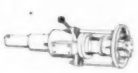


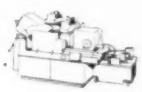

figure 5

Drawing illustrating thread rolling operation

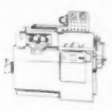
Threading Machines

Die Heads—Rotary & Stationary


Taps—Collapsible & Solid Adjustable

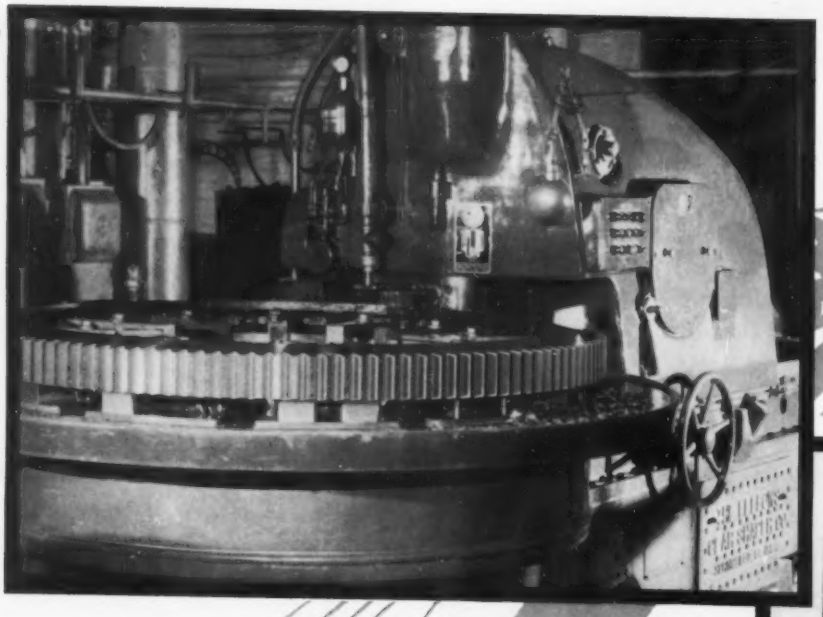

Centerless Thread Grinding Machines

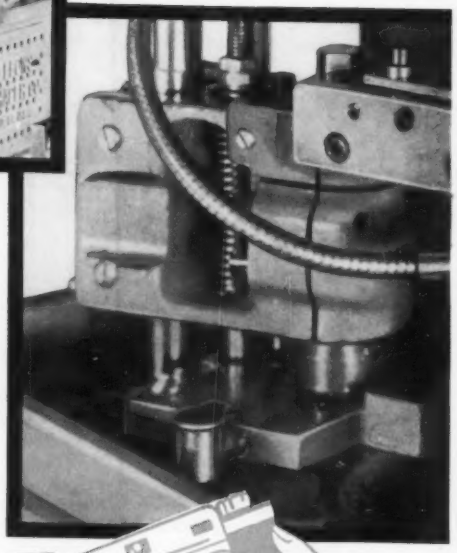
Thread Rolling Tools


Thread Rolling Machines

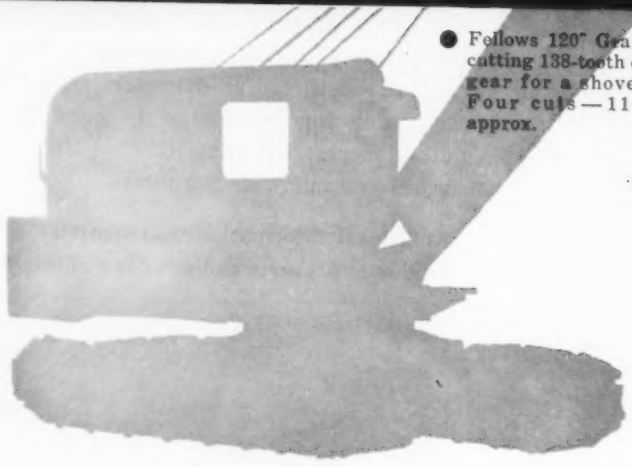
# GEARS to Turn a Giant

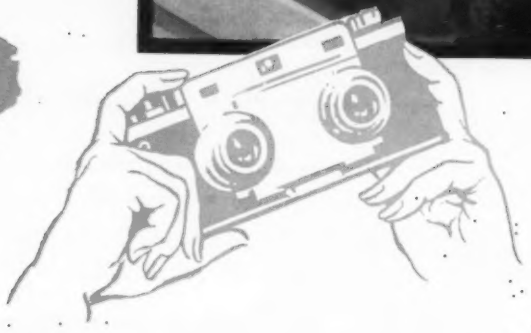
...or





● Follows 120" Gear Shaper cutting 138-tooth cast steel gear for a shovel-crane. Four cuts — 1181 min. approx.





THE PRECISION LINE

# Shovel Adjust a Small Camera

***For any size gear in the range, new Fellows Gear Shapers lower costs because of their versatility, fast set-up and production speed.***

● Fellows 3" Fine-Pitch Gear Shaper cutting 27-tooth, 0.4219" P.D. steel camera gear. One cut—35 seconds, floor to floor.

Whatever capacity you need, from 1/16" to 120" P.D. there's a Fellows Gear Shaper that will pay dividends in lowered production costs. In many plants, new Fellows machines have cut unit costs by more than a third and repaid the original investment in a very few years.

In every size range, new Gear Shapers speed set-ups and change-overs, increase production flexibility as well as cutting speeds and feeds. Rigid construction makes it possible to hold close tolerances on internal and external spurs, helicals and herringbones, as well as on an almost unlimited variety of cams, splines and other non-involute shapes.

Your Fellows Representative can *show* you in your plant where you can cut production costs with newer machines. Ask him today. Simply write, wire, or phone any Fellows office.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont
Branch Offices: 1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

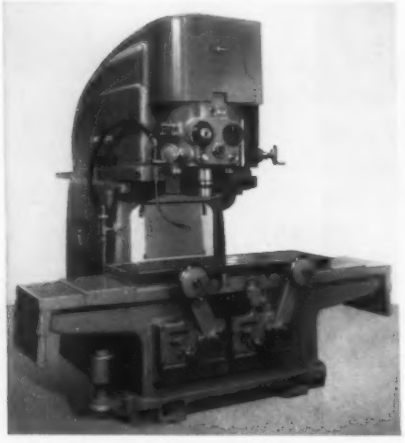
**Fellows** *Gear Production Equipment*

## To Profile Mill Slots in Cylindrical Surfaces . . .

# Coordinates Straight Line and

Milling a variable pitch slot in a cylindrical surface is no longer the costly toolroom job it once was. Cincinnati Milling Specialists have given the operation a production status by coordinating straight line and rotary motions. The 360 Degree Automatic Tracing Unit, which may be supplied with CINCINNATI Hydro-Tel Milling Machines, handles the coordination job with no attention whatever from the operator. The machine table is disconnected from the hydraulic system and locked in position. Cross feed of the ram, as always, is controlled by the Automatic Tracing Unit. This unit, through a hydraulic cylinder and rack and pinion arrangement, also controls rotary feed of the fixture cradles holding the work and master. The combination of these two feed motions produces smooth, accurate slots in the internal arc of the part illustrated at the right. ¶CINCINNATI Hydro-Tel Milling Machines have the potential for many types of unusual tracer controlled milling operations. And Cincinnati Engineering Service is ready to help you with the tooling problems, or prepare a cost analysis of your present equipment and methods versus a new Cincinnati production package. May we hear from you?

Slots in internal arc of this part are automatically profile milled on the CINCINNATI equipped 16" Vertical Hydro-Tel illustrated at the right. Time per operation, including rough and finish cuts, about 1.8 minutes.



**CINCINNATI 16" Vertical Hydro-Tel Milling Machine.**
Catalog No. M-1497-1.

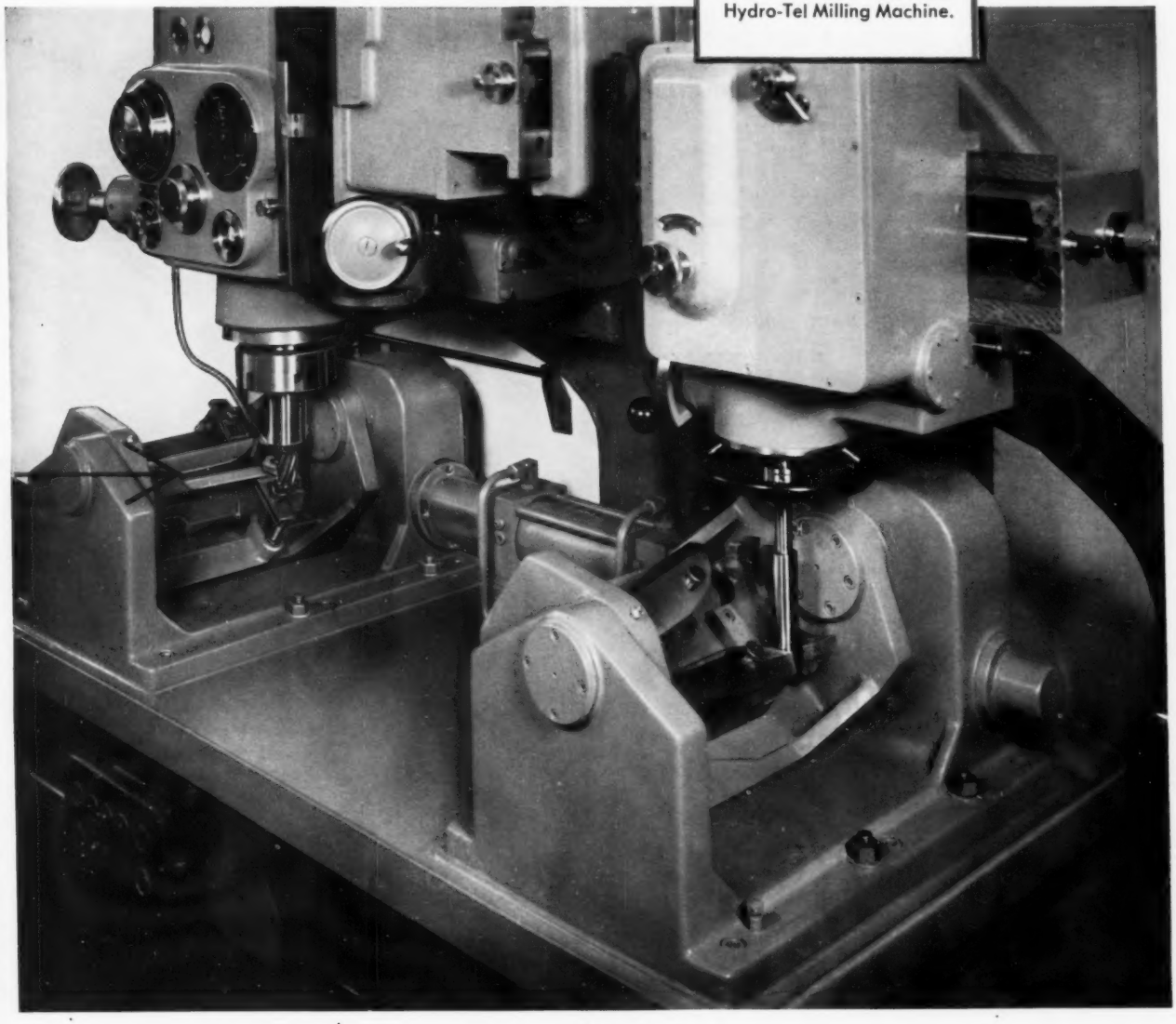
**CINCINNATI®**

**MILLING MACHINES • BROACHING MACHINES • CUTTER METAL FORMING MACHINES • HARDENING MACHINES •**

# Hydro-Tel's 360° Automatic Tracing Unit

## *Rotary Motions*

Rotary feed motion of trunion-mounted work and master cradles is coordinated with cross feed of ram by 360° Automatic Tracing Unit mounted on CINCINNATI 16" Vertical Hydro-Tel Milling Machine.

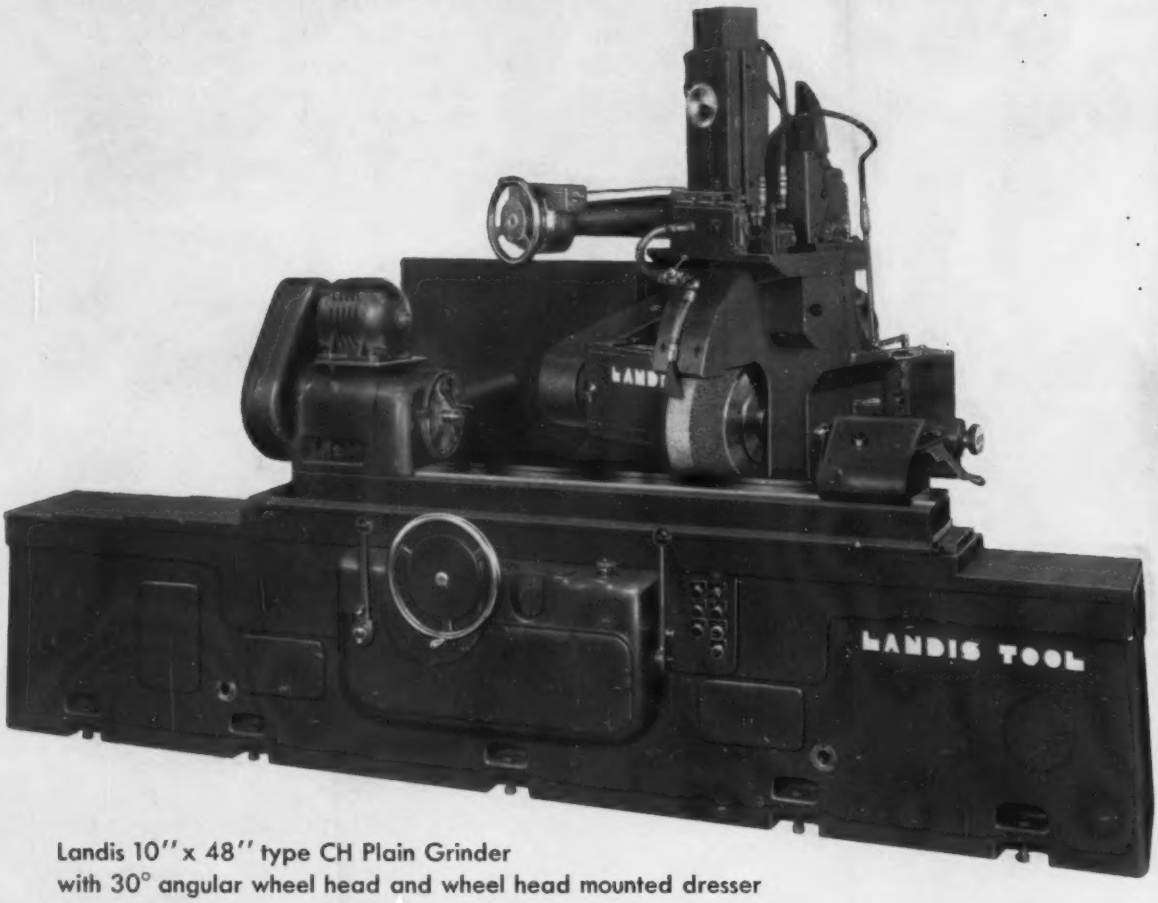


AND TOOL GRINDERS • SPECIAL MACHINE TOOLS
CUTTING FLUIDS • GRINDING WHEELS

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI 9, OHIO

# *One* new Landis grinder over *three* older machines

***Landis plain grinder with 30° angular wheel head grinds 3 diameters and face at one time. Replaces 3 single operation grinders.***




Landis 10″ x 48″ type CH Plain Grinder
with 30° angular wheel head and wheel head mounted dresser

**LANDIS**
**precision grinders**

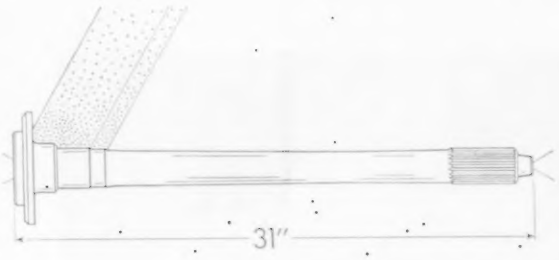
LANDIS TOOL COMPANY

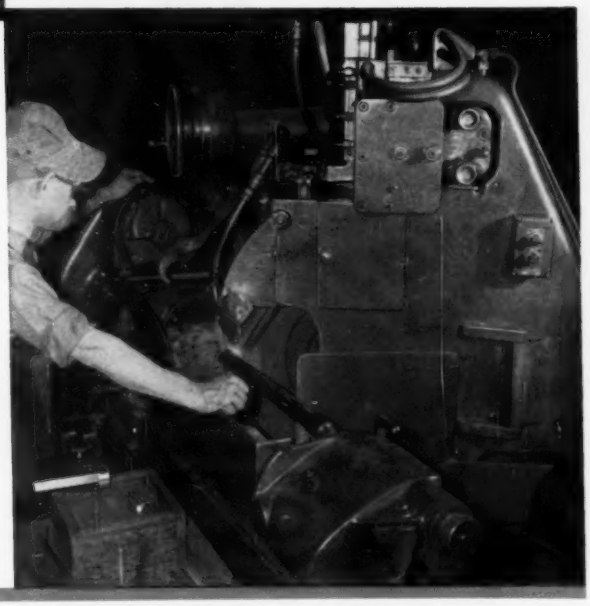
# steps up production 20%

**production data**

| | |
|---|---|
| Machine: | New Landis 10'' x 48'' type CH Plain Grinder with 30° angular wheel head |
| Part: | Tractor axle |
| Operation: | Infeed grinds 3 diameters and adjacent face in one operation |
| Production: | 35 parts per hour |
| Material: | 9490 "H" steel forging |
| Hardness: | 40-46 Rockwell C |
| Stock removal: | .020''-.023'' on diameters<br>.008'' on face |
| Finish: | 16 RMS on diameters<br>32 RMS on face |
| Tolerance: | .0005'' on diameters |

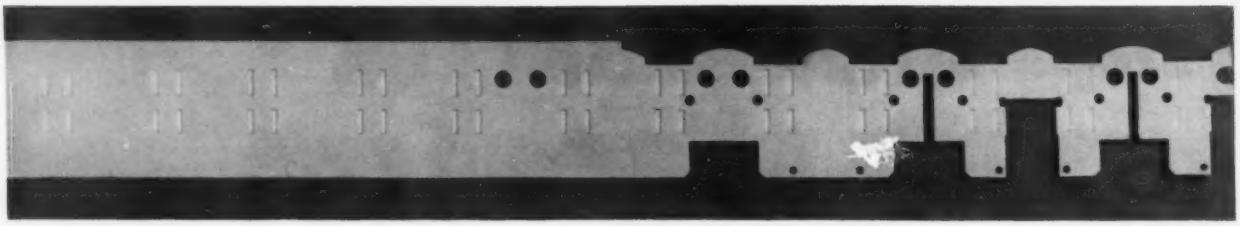
**Accurate wheel dressing** is obtained with the hydraulically operated profile wheel dresser. The entire face of the wheel is dressed in one continuous traversing movement.



**A lateral locating gauge** is used to establish the correct position of the workpiece. Completely automatic feed allows the operator to dog the next workpiece during the grinding cycle.

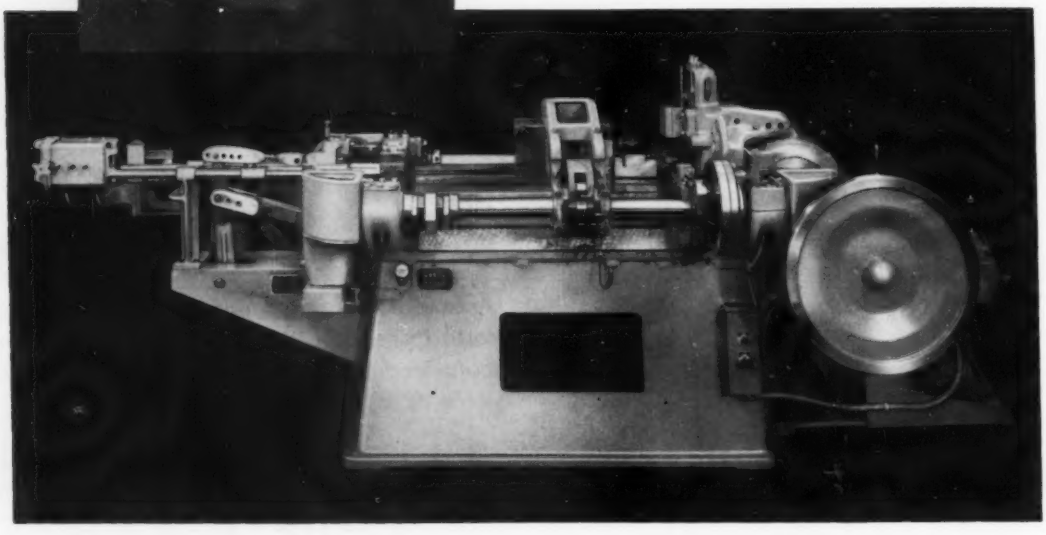
WAYNESBORO, PENNSYLVANIA

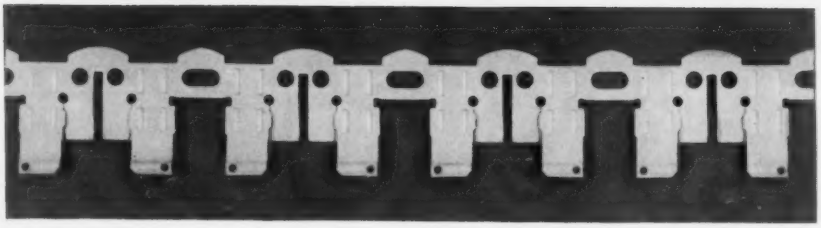


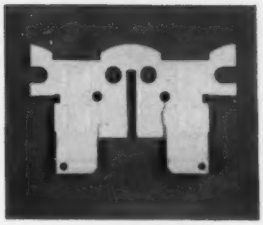
# ON JOBS LIKE THIS CORBIN TURNS TO

The Corbin Latch Bolt Retractor shown at left illustrates the unique ability of the U. S. Multi-Slide to produce thousands of uniformly precise parts—faster and better. Completely formed to close tolerances from strip metal, this part is non-jamming, self-aligning and practically indestructible. Thus, it imports to Corbin Locksets the famous "velvet glide" knob action, long life and trouble free service—qualities which were found previously only in higher priced custom units, but which are now, thanks to U. S. Multi-Slides, an integral part of every Corbin Standard Duty Residential Lockset.

Below: The U. S. No. 35 Multi-Slide Machine used, with appropriate tooling, to produce the Corbin Latch Bolt Retractor shown above.







# U.S. MULTI-SLIDES®

The Corbin ball bearing latch bolt retractor is just one of a multitude of stampings which can be produced—complete, without secondary operations, handlings or inspections—on U. S. Multi-Slide Machines. In the U. S. Multi-Slide, a combination of motions built in to the machine itself greatly simplifies the designing of tools to fabricate precision formed metal stampings. Because these motions are part of the standard machine equipment, it is not necessary to incorporate complicated movements into the dies. Standard equipment on the machine includes: ram action for cutting, piercing, trimming, embossing, etc.; a four-slide forming position; and vertical movement for stripping and transferring. U. S. Multi-Slide Machines are built in four sizes, and on the three larger units it is possible to use two or more rams simultaneously. These features make the U. S. Multi-Slide extremely versatile in the automatic, high-speed production of all types of formed metal stampings.

If you want to produce parts uniformly . . . at high speeds . . . and to close tolerances, write for a copy of Bulletin 15-M or send part drawings or samples for our recommendations.

## U. S. TOOL COMPANY, Inc.

AMPERE (East Orange) NEW JERSEY

Builders of U. S. Multi-Slides—U. S. Multi-Millers

U. S. Automatic Press Room Equipment—U. S. Die Sets and Accessories

For more information fill in page number on Inquiry Card, on page 197

# Precision Bores Nine Different Planetary Drive Housings

This new Cross dial machine bores the planet pinion holes in planetary drive housings. Production of parts with three pinions is seven per hour and with four pinions five per hour at 100% efficiency. Changeover from one part to the other can be accomplished quickly and easily.

Housings are manually loaded into the fixture in the center of the index table. The automatic cycle begins when the cutter head moves horizontally to bring the first spindle into position to rough bore the pin holes. Spacing is established by the index table, which positions the part for boring one hole at a time. The cutter head then indexes the second spindle into position and the holes are semi-finish bored. Finally, the third spindle indexes into position for finish boring. After all cuts are completed on each hole, the head moves horizontally away from the work piece to complete the automatic cycle.

Roughing and semi-finishing operations are performed with multiple blade cutters, while the precision finishing operation is accomplished with a single point tool.

Other features include: complete interchangeability of all standard and special parts, construction to JIC Standards, hardened and ground ways, hydraulic feed and rapid traverse, and automatic lubrication.

*Established 1898*

THE CROSS CO.

*First in Automation*

PARK GROVE STATION • DETROIT 5, MICHIGAN

Another Special by Cross
CROSS
ROSS

# CINCINNATI keeps these

CINCINNATI FILMATIC 10"R x 36" Plain Hydraulic Grinding Machine. Catalog No. G-661-1.

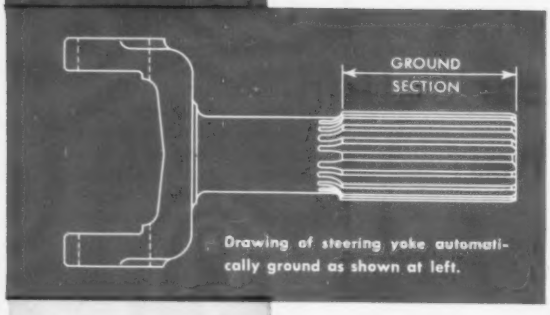
**Horizontally mounted Air-Electric Gage Sizing Equipment,** on CINCINNATI FILMATIC 10"R Plain Grinder, keeps size and production under control. Operation performed—grinding spline section of automotive steering yokes.

FILMATIC

**CINCINNATI®**

CENTERTYPE GRINDING MACHINES • CENTERLESS GRINDING
ROLL GRINDING MACHINES • SURFACE GRINDING MACHINES •

# tough grinding jobs under control



Drawing of steering yoke automatically ground as shown at left.

## *Cycle Time Stabilizer automatically compensates for wheel wear*

Spline sections and other cutaway diameters are tough on grinding wheels. Ordinarily, frequent adjustments for size and/or length of infeed cycle are required. Cincinnati cures these ills of rapid wheel wear with Automatic Air-Electric Gage Sizing. An exclusive extra advantage of this equipment, *Cycle Time Stabilizer*, does the trick. It automatically adjusts the length of infeed cycle to compensate for wheel wear and truing. Cycle time cannot increase; rate of production cannot decrease. ¶A horizontally mounted variation of Automatic Air-Electric Gage Sizing is incorporated in the CINCINNATI FILMATIC 10"R Plain Grinder abbreviated in the illustration at the left. This machine does an excellent job of grinding the spline diameters of steering yokes. Other automatic features which help to keep the cost of production at a minimum include:

**Push-button Automatic Dual Rate Infeed**
**Behind-the-wheel Truing with Cycle Counter**
**Automatic Positioning of Headstock Spindle**
**Gap Eliminator**
**Flat top table, work cradles, and hydraulic footstock**

Of course, standard machine features contribute importantly to the way in which Cincinnati keeps tough grinding jobs under control. FILMATIC bearings, for example, easily withstand heavy loads, shock loads, or any load imposed by the grinding wheel. Other advantages offered by Cincinnati include imaginative engineering service and a selection of over 160 sizes, types and styles of precision grinding machines. All are good medicine for your machine tool replacement or additional equipment program. Complete information on the standard 10"R Plain Grinder may be obtained by writing for catalog No. G-661-1. Sweet's Machine Tool File contains brief specs.

CINCINNATI

MACHINES • MICRO-CENTRIC GRINDING MACHINES
CHUCKING GRINDERS • CENTERLESS LAPPING MACHINES

**CINCINNATI GRINDERS INCORPORATED**
**CINCINNATI 9, OHIO**

Shutdowns
for lubrication
cut in half
with

# RYKON

Grease

**Dollars in production time saved by using RYKON in high temperature service at Northwestern Steel & Wire Company**

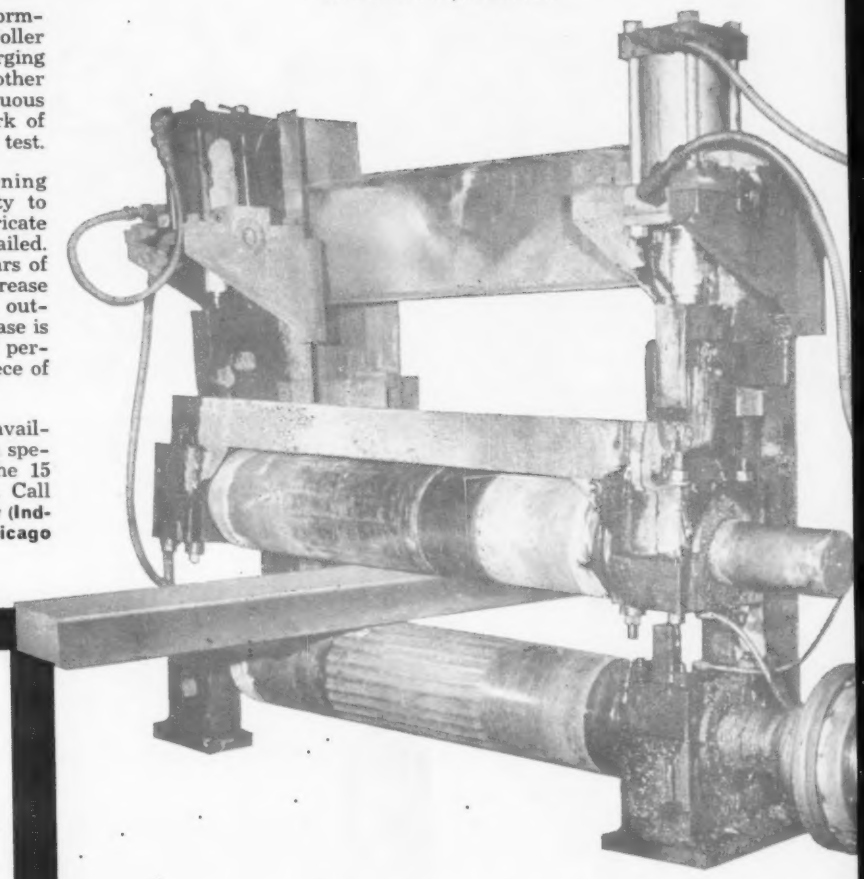
Bearings on the 46-inch blooming mill manipulator and side guard carrier had to be lubricated twice each eight-hour shift before RYKON Grease was used. The mill had to be shut down while the lubrication work was performed. Now with RYKON, the bearings are greased once each shift. Maintenance men find rollers and pins are still well lubricated. The rollers are subject to almost constant heat and water washing. Steel blooms heated to approximately 2300° F. are just 18 inches away from the RYKON lubricated bearings. The lubricating properties of the grease are unaffected by the heat.

**RYKON Grease** delivers similar performance results elsewhere in the plant. In roller bearings on the reheating furnace charging tables, in pinch roll bearings and in other trouble spots, where heat and continuous water washing would make short work of other greases, RYKON stands up to the test.

**A unique nonsoap,** organic thickening agent gives RYKON Grease the ability to provide lubrication in tough-to-lubricate spots long after other greases have failed. This thickener is the result of five years of research effort by a Standard Oil grease research team working to develop an outstanding industrial grease. RYKON Grease is a true multipurpose grease capable of performing all lubrication jobs on one piece of equipment or often in an entire plant.

More facts about RYKON Grease are available from the Standard Oil lubrication specialist that is near you in any of the 15 Midwest and Rocky Mountain states. Call him. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

Bloom in the pinch roll. A 2300° F. bloom goes through while water washes continuously. **RYKON** Grease keeps this equipment lubricated at all times in spite of heat.



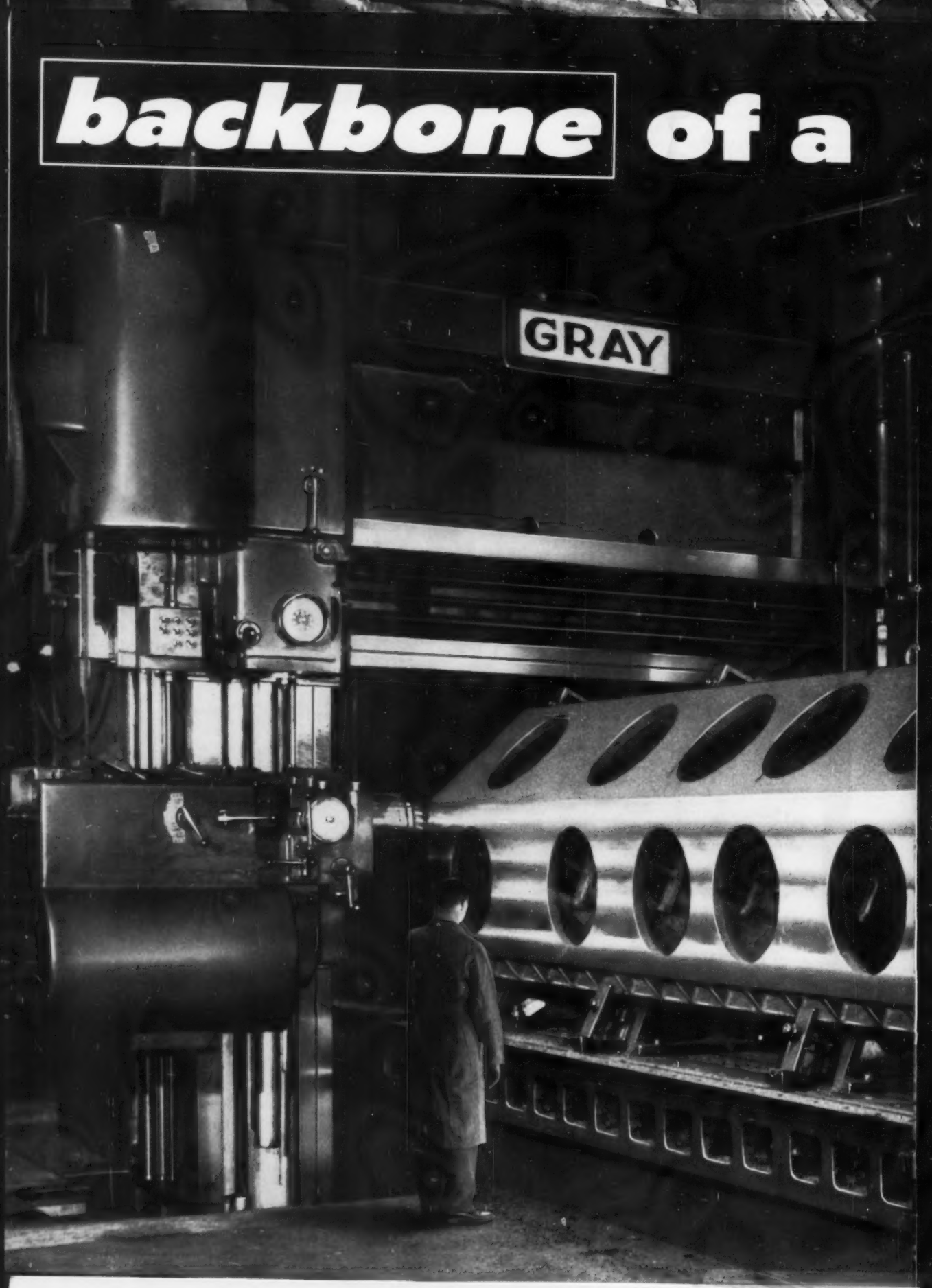
*Quick facts about*
RYKON Grease

- Stable at high temperatures. At sustained high temperatures RYKON Grease remains soft and grease-like.
- Resistant to water washing.
- Mechanically stable. Minimum change in consistency in service.
- Resistant to oxidation. Thickener acts as an inhibitor.
- Exceptional rust preventive properties.

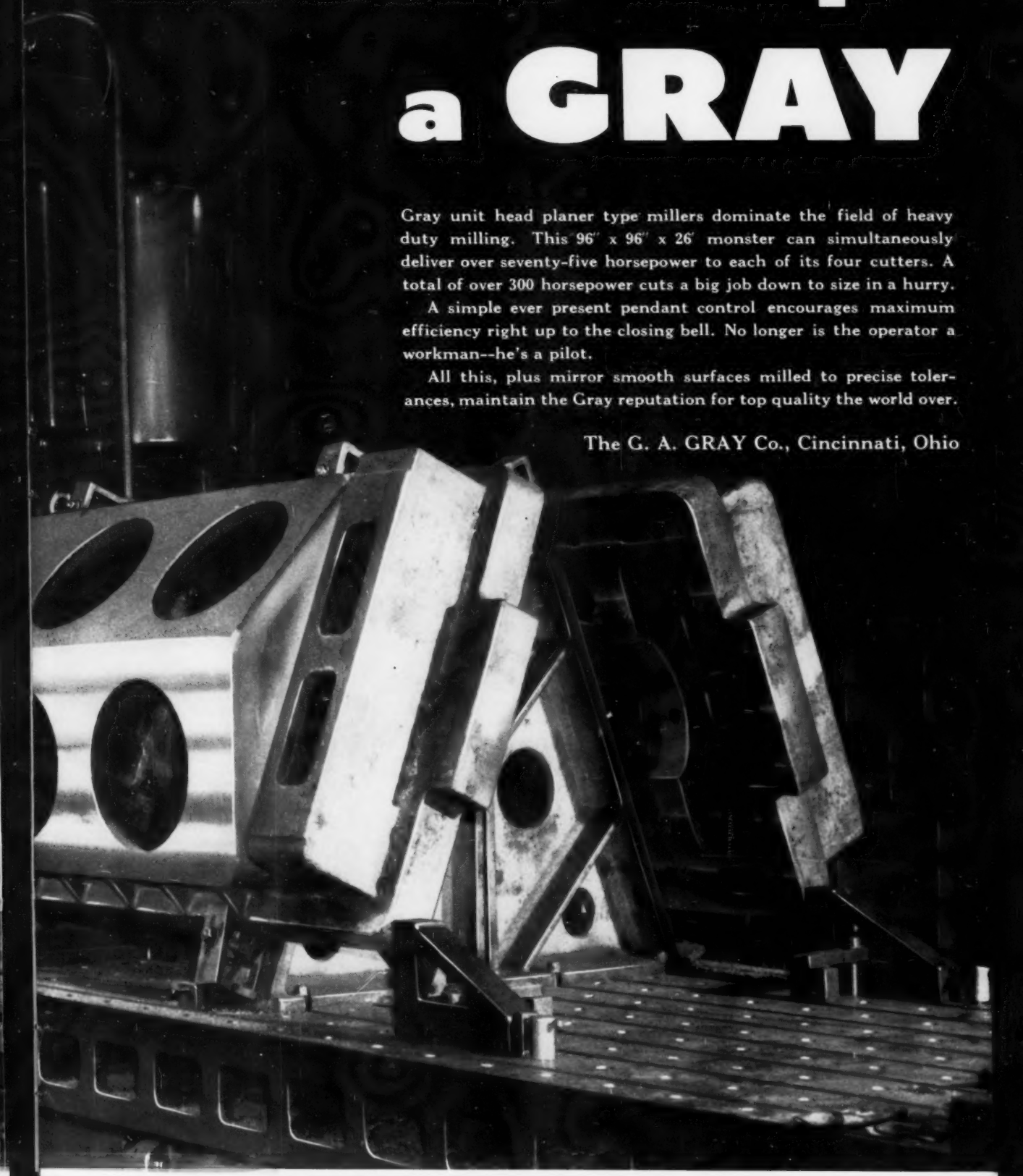
You expect more from STANDARD and get it!

Lubrication time cut. Mill feeder pinch roll bearings formerly lubricated twice each eight hours. Now with RYKON Grease lubrication is needed only once each shift. Elbert Dean, Northwestern Steel lubrication engineer, and Standard Oil lubrication specialist, Charles Daub, inspect bearings. Counseling people who have lubrication jobs like this is work for which Chuck Daub is well-qualified. Chuck has 12 years' experience in lubrication technical service work. He has an engineering degree from Illinois Institute of Technology and has completed the fifteen week Standard Oil Sales Engineering School course.

# backbone of a



# modern shop a GRAY

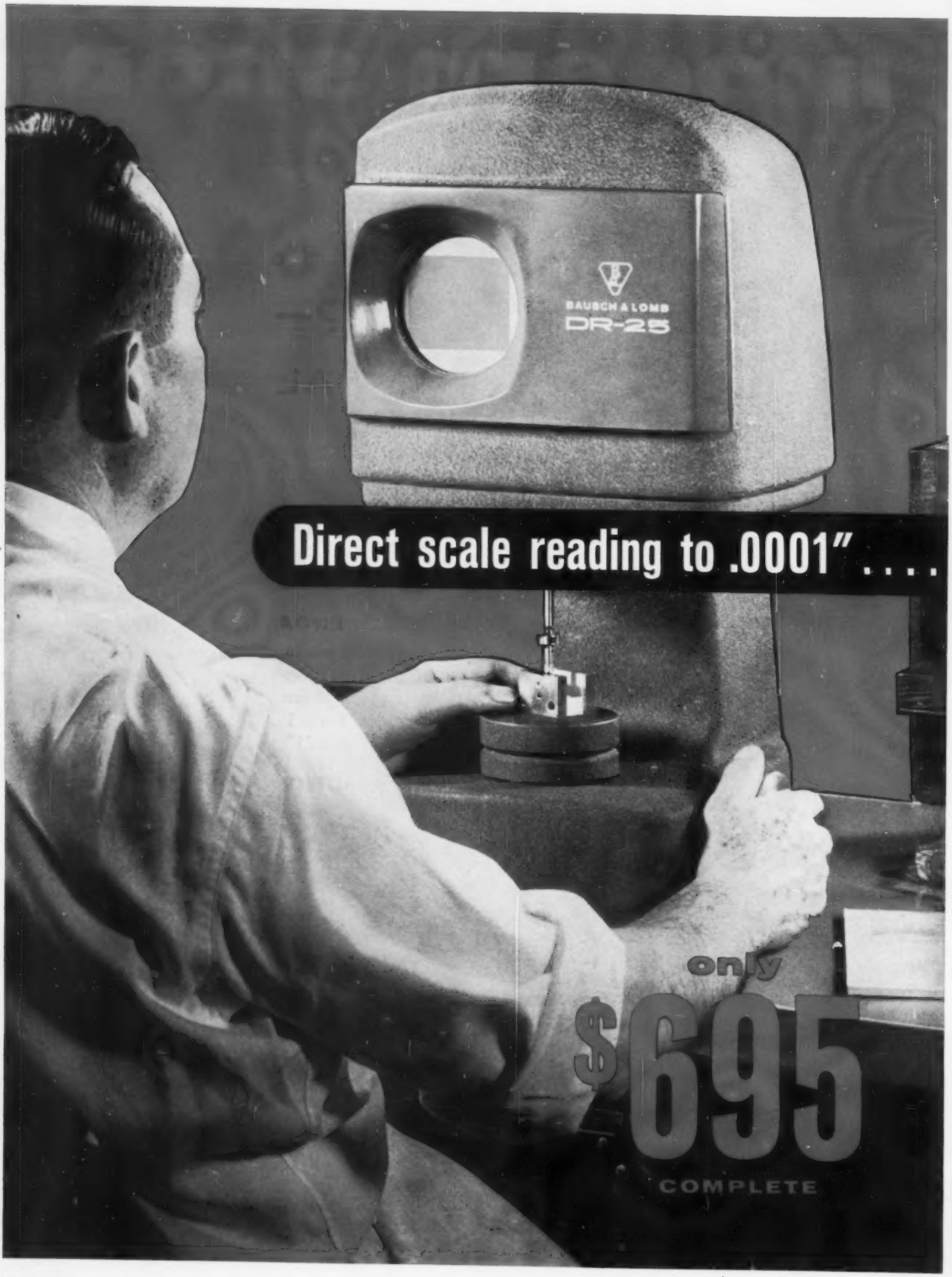


Gray unit head planer type millers dominate the field of heavy duty milling. This 96" x 96" x 26' monster can simultaneously deliver over seventy-five horsepower to each of its four cutters. A total of over 300 horsepower cuts a big job down to size in a hurry.

A simple ever present pendant control encourages maximum efficiency right up to the closing bell. No longer is the operator a workman--he's a pilot.

All this, plus mirror smooth surfaces milled to precise tolerances, maintain the Gray reputation for top quality the world over.

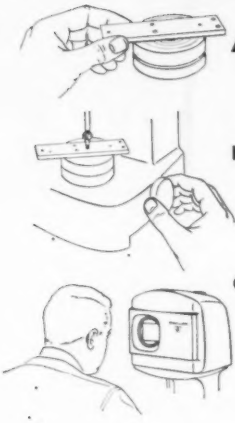
The G. A. GRAY Co., Cincinnati, Ohio


BAUSCH & LOMB
DR-25
Direct scale reading to .0001" . . . .
only
$695
COMPLETE

# New! BAUSCH & LOMB DR-25 OPTICAL GAGE

## .....0" to 3" range...accurate to .000025"!

### FAST, EASY AS A-B-C!



**A** Just set part to be measured on anvil . . . no masters or set gages needed.

**B** Turn knob to lower spindle . . . it will stop automatically on contact, with constant spindle pressure.

**C** See precise measurement at a glance . . . direct-reading scale is illuminated, magnified. No eyestrain, no conversion, no guesswork.

### DEPENDABLE ACCURACY!

Direct readings to .0001"; keeps production to quality specification. Master scale ruled on world-famous B&L Grating Ruling Engine. Every DR-25 Optical Gage is accurate to 0.000025".

### PRACTICAL, ALL-PURPOSE!

Direct scale measurement of depth, thickness, height, diameter, taper, angularity of surfaces, runout. Large work table makes it easy to adapt special fixtures. Deep (4¼") throat, open sides and large staging area accommodate widest variety of work.

ON-THE-JOB DEMONSTRATION!
NO OBLIGATION...
JUST MAIL COUPON TODAY!

BAUSCH & LOMB
SINCE B&L 1853

*Distributed in the U.S.A. through the DoALL Co.*

**BAUSCH & LOMB OPTICAL CO.**
**85431 St. Paul St., Rochester 2, N. Y.**

☐ I'd like a free on-the-job demonstration of the new B&L DR-25 Optical Gage, with no obligation on my part.

☐ Please send Catalog D-285.

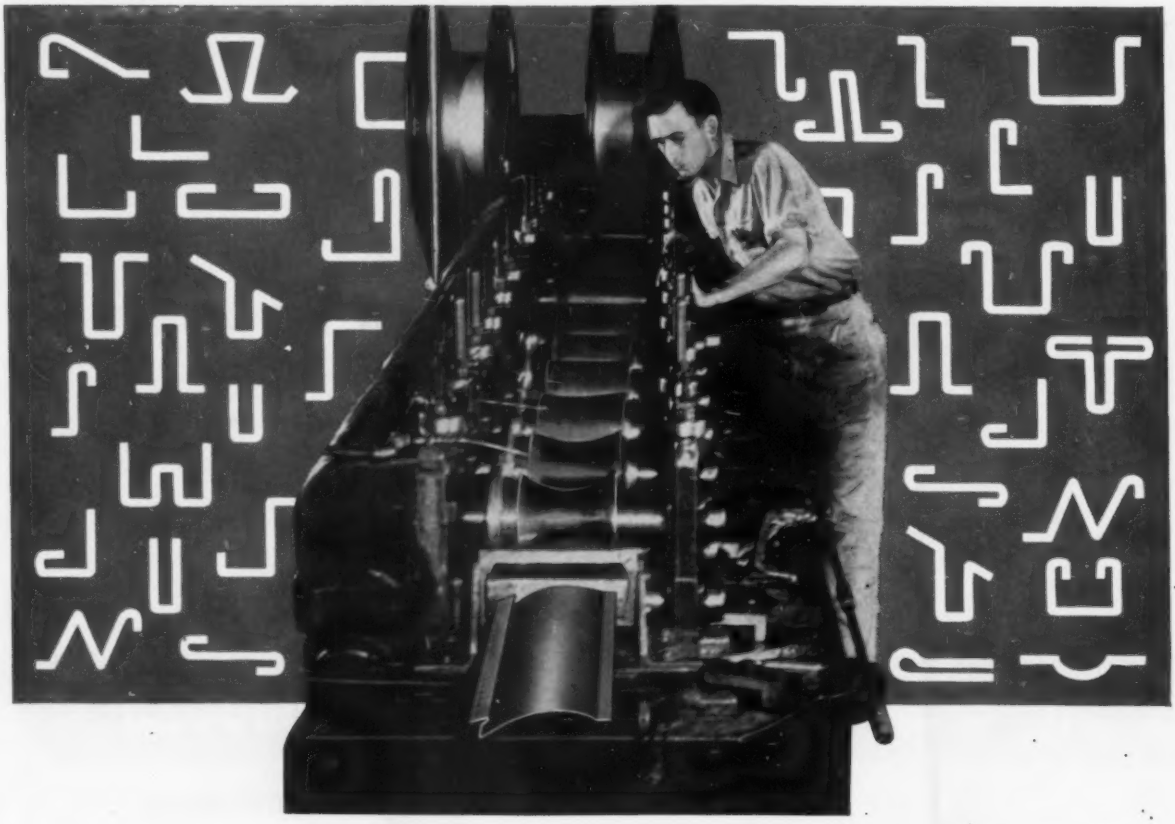
NAME .....

COMPANY ..... TITLE .....

ADDRESS .....

CITY ..... ZONE ..... STATE .....

For more information fill in page number on Inquiry Card, on page 197



# With a Yoder...ONE MAN PRODUCES 20,000 FEET OF SHAPES A DAY!

Cold-roll forming with a Yoder Roll-Forming machine makes spectacular production possible in many metalworking applications and industries.

A multitude of shapes, simple or complex, produced from a wide variety of coated or uncoated stock, and destined for a virtually endless list of purposes, can be easily, quickly and economically produced with a Yoder cold-roll forming machine.

Whether it be moldings, structurals, siding, roofing, tubulars, cabinet shells, or any one of a thousand requirements, it can be quickly produced with accuracy and uniformity the Yoder way. The conversion cost is usually so low that even part-time operation makes a Yoder cold-roll forming line a profitable investment.

A great many modifications of the basic shape such as welding, coiling, ring forming, notching, perforating, embossing and cutting to length, can be simultaneously introduced with little or no additional labor cost. It will pay you big dividends to fully investigate the advantages of Yoder cold-roll forming. A fully-illustrated, 88-page book clearly discusses every important aspect of this amazingly versatile method of metal fabrication... it is yours for the asking.

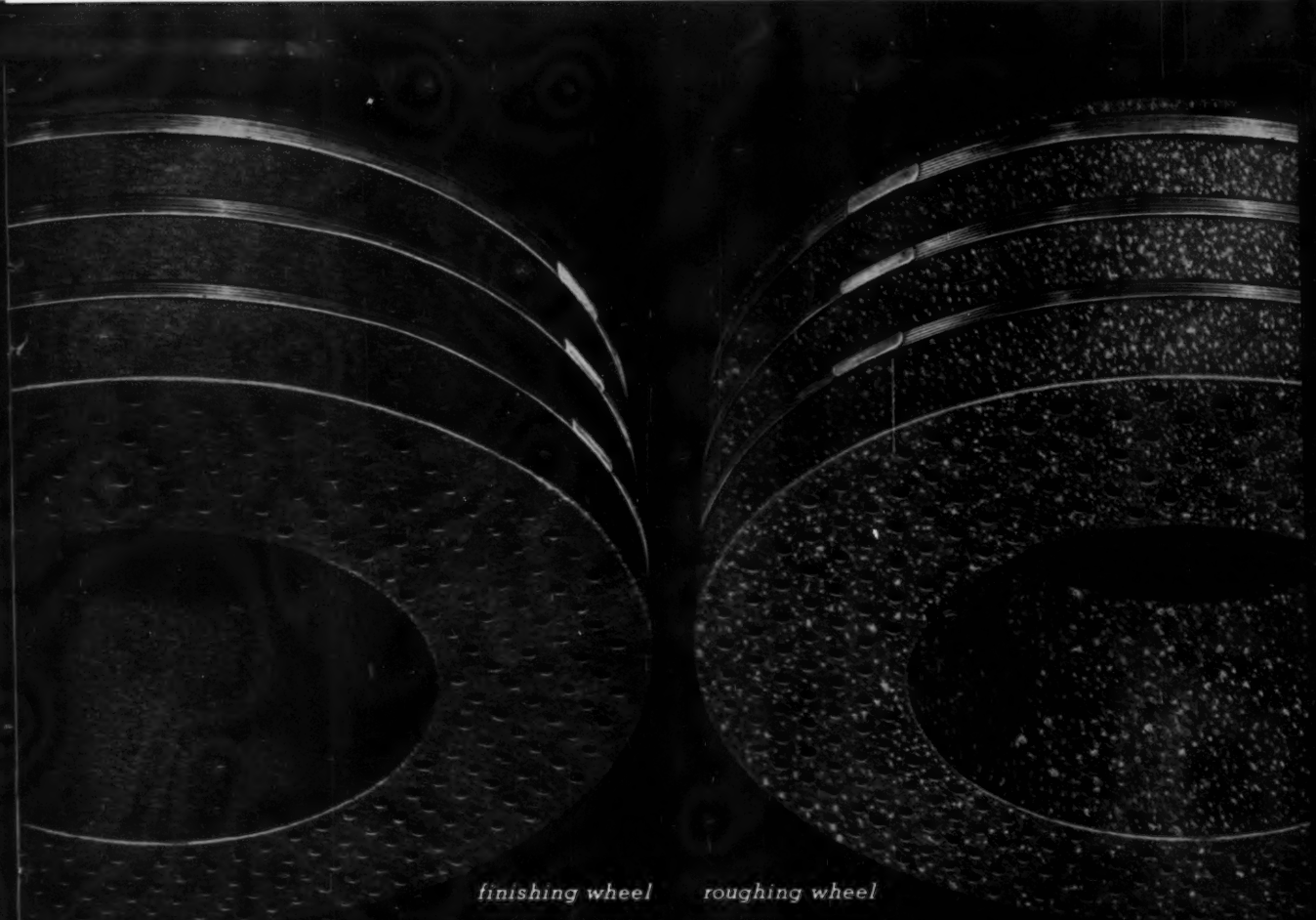
**THE YODER COMPANY**
**5504 Walworth Ave. • Cleveland 2, Ohio**

ENGINEERING **YODER** MANUFACTURING

**COLD ROLL FORMING MACHINES**
**PIPE AND TUBE MILLS (ferrous or non-ferrous)**
**ROTARY SLITTING LINES**

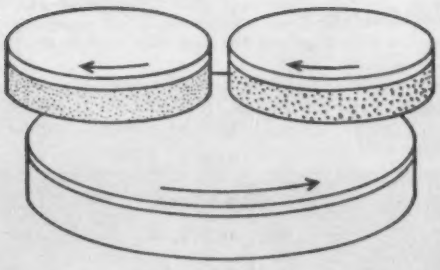


For more information fill in page number on Inquiry Card, on page 197



*finishing wheel* *roughing wheel*

# Gardner abrasives double production in both rough and finish grinding



**... greater wheel life due to improved combination of grade and grain.**

| | |
|---|---|
| Workpiece | water pump housing |
| Rough grind | 23,000 parts per disc |
| Finish grind | 36,000 parts per disc |
| Former production | 11,400 and 18,100 parts per disc |

*Specifications for Gardner abrasives are written by men who are thoroughly experienced in both abrasives and grinders . . . Your assurance that your problem can be solved practically, economically.*

**GARDNER**

**abrasive discs**

BELOIT, WISCONSIN

# The big 3 inch

## G&L 300-T table-type horizontal boring, drilling and milling machine

Here's America's most versatile 3" dia. spindle horizontal machine! With truly exceptional efficiency it bores, mills, drills or taps. Generous bearing surfaces provide maximum rigidity to give the 300-T outstanding ability to consistently produce excellent finishes with precision accuracy *through the entire machining range.* For further facts, call your nearest G&L representative or write direct.

**FEATURES THAT CAN PRODUCE MORE PROFIT FOR YOUR SHOP:**

- **45 spindle speeds, 36 spindle feeds** provide exact choice for any type tooling or work material.
- **Full length precision scales and verniers** easily read to .001" for headstock, table, saddle and end support.
- **Hardened bed and saddle ways** provide longer life to maintain higher machining accuracy.
- **Rotary selectors and rotary reading dials** for fast, accurate selection of feeds and speeds.
- **23 milling feeds.** Ideal for a broad variety of milling.
- **Independent operation;** all units operate independently in either direction, simplifying machine handling and control.
- **Automatic electric positioning device** accurately controls distances between machined holes. Makes possible positive machine settings for boring operations repetitive to .0002". Ends pre-layout and manual adjustments. (*)
- **Improved measuring device** for headstock, table and saddle provides extreme accuracy in positioning with readings to .0001". (*)
- **Exclusive G&L "Lubri-Cool" system** assures accurate operation under any temperature condition. (*)

*(*) Optional equipment*

## G&L *and* HYPRO DIVISION

### GIDDINGS & LEWIS MACHINE TOOL CO.

FOND DU LAC, WISCONSIN

G-94

*Builders of the world's finest heavy-duty Table, Floor and Planer Types Horizontal Boring, Drilling and Milling Machines; HYPRO Double Housing and Openside Planers; Planer-Type Milling Machines; Vertical Boring and Turning Mills; Spar and Skin Milling Machines; VARIAX Milling Machines and NUMERICORD-numerical continuous path tape controls.*

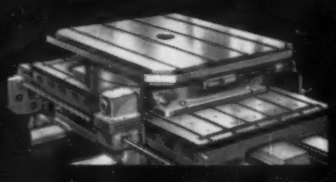
**Saddle supports and auxiliary runways** recommended for greatest accuracy where operations are performed progressively on different parts of the workpiece, and on all work where precision measuring devices are used.

**Over-the-floor type auxiliary runways** provide complete location flexibility. Especially designed to meet problems created by foundation limitations.

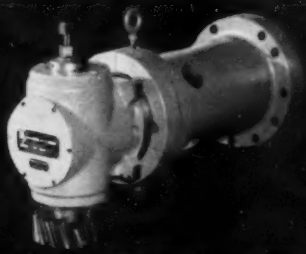
**Built-in rotary tables** eliminate multiple work setups. Two sizes: 30" x 36" and 36" x 42"

# FAST, ACCURATE, VERSATILE, PRODUCTIVE

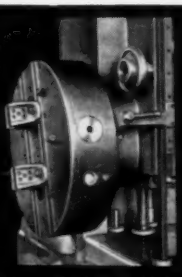
**G&L Model 300-T table-type Horizontal** with automatic electric positioning device completes 47 distinct operations in less than three hours on this complex gear case housing. It bores, drills, mills, counterbores and reams. The 300 Series machines are available in two models with a wide range of specifications: Standard Model 300-T and Model 300-RT machine with a built-in rotary table.



**Combination plain, hand and power feed rotary table** — fast, accurate hand or power indexing. Available with round, square or rectangular platens in various sizes.



**Angular milling attachment** operates at right angles to machine spindle. Unusual flexibility for machining hard-to reach surfaces.



**Continuous feed facing and boring heads** used separately or in combination with other attachments or accessories for turning, facing, threading, back facing, grooving, etc. Telescopic right angle and facing tool holders, and high speed grinder are also available.

**C. T. WEITZEL**, President, Mechanical Specialties Co.
5700 West 96th Street, Los Angeles, California

# a man who came to Fair Street

**"We were skeptical of the claims for the JIGMIL Technique until we came to Fair Street. There we found the machine that met our need for accuracy and versatility with features to spare.**

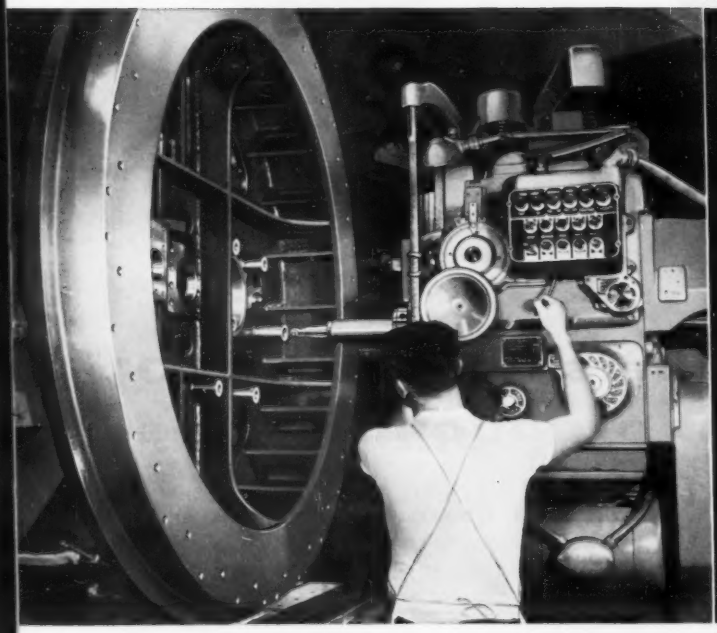
"As a contract manufacturer of tools, dies and precision components, we long felt the need for something new in the way of a precision boring and milling machine. Among other things, we wanted a machine having a configuration which would permit easy set-ups of a wide range of awkward and bulky work pieces. In 1946, we heard about the JIGMIL and the JIGMIL Technique of jigless boring. The claims for this machine were so unusual that we discounted much of what we heard, but decided that we should at least look into it. At Fair Street, we found the machine that met all our requirements with features to spare. Our first JIGMIL put us in a position to handle an entirely different class of work and without doubt, aided materially in our subsequent growth and development. Today, we have four JIGMILS which are consistently busy and consider them ideal job shop machines."

**C. T. WEITZEL**

**DE VLIEG MACHINE COMPANY, 450 FAIR STREET**

## SOME OF OUR JIGMIL USERS

Airesearch Mfg. Co., Div. The Garrett Corp.
Bell & Gossett Co.
The Brush Beryllium Co.
H. W. Butterworth & Sons Co.
Byron Jackson Pumps, Inc.,
a Subsidiary of Borg-Warner Corp.
Cameron Iron Works, Inc.
The Cleveland Pneumatic Tool Co.
Delco-Remy Div. General Motors Corp.
Eastern Air Lines, Inc.
Euclid Div. GMC
Fairchild Camera and Instrument Corporation
General Atomic Div. General Dynamics Corp.
Goodyear Aircraft Corp.
C. L. Gougler Machine Co.
Greenlee Bros. Co.
Hoover Tool & Die Co.
Hughes Aircraft Co.
The Hydraulic Press Mfg. Co.
I-T-E Circuit Breaker Co.
Kaiser Industries Corp.
Koppers Co., Inc.
Kurt Mfg. Co.
Librascope Incorporated
Lycoming—Div. of Avco Manufacturing Corporation
Manning, Maxwell & Moore, Inc.
Massachusetts Institute of Technology
Maytag Co.
Menasco Mfg. Co.



## A FEW PROVEN ADVANTAGES OF THE JIGMIL TECHNIQUE

- Eliminates cost of expensive jigs and production delays resulting from their manufacture.
- Simplifies tooling.
- Employs automatic functions to reduce factors of human error even in close tolerance work.
- Makes possible greater flexibility of product design.
- Improves end product by permitting interchangeable assembly of parts without hand fitting.
- Increases production and product accuracy.

**ACCURACY IS AN ECONOMY!**

## A TYPICAL EXAMPLE OF JIGMIL PRECISION
applied to the guided missile program

Mechanical Specialties Co. uses the JIGMIL Technique for machining pieces such as this 3500 lb. traversing-launching ring for guided missiles. Part is set-up on a Model 3B-96 JIGMIL. Critical machining involves boring 24 indexing holes on a 60″ dia. with hole spacing of ± .0005; an interior hole pattern of 5 holes coordinated to a master within ± .00025; 30 additional holes in a 30″ x 36″ rectangular pattern to ± .001; accurate milling of locating pads and boring of 3 large critical bores to ± .001.

Our newest catalog will help you decide. May we send it?

McKiernan-Terry Corporation
National Cash Register Co.
Norden-Ketay Corp.
Robbins & Meyers, Inc.
Rocketdyne Div., North American Aviation, Inc.
Rohr Aircraft Corp.
AC Spark Plug Division, General Motors Corp.
Sperry Farragut Co., Division of Sperry Rand Corp.
Stratos Div. Fairchild Engine & Airplane Corp.
Sundstrand Machine Tool Co. (Aviation Div.)
Sylvania Electric Products, Inc.
Utica-Bend Corp., a Subsidiary of
Curtiss-Wright Corporation

WILL YOU BE THE NEXT TO VISIT FAIR STREET

# DeVlieg

## SPIRAMATIC JIGMILS®

ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS

FERNDALE • DETROIT 20

"Buffalo" No. 16 DRILL

# leading aircraft builders use "BUFFALO" to cut costs, boost production, meet

**DESIGNED SPECIFICALLY FOR AIRCRAFT BUILDERS**

**SHAPES, FORMS, BENDS—QUICK, EASY RETOOLING—VARIABLE SPEED DRIVE**

The "Buffalo" Type "OA" Bending Roll was designed in cooperation with prominent aircraft manufacturers to supply a bending roll that would meet their stringent requirements. The "OA" bending roll performs complicated bending jobs speedily and efficiently. Complete retooling can be accomplished in a very few minutes. Special rolls and attachments are available to extend its range of usefulness. Speeds from 15 to 60 R.P.M. are at the command of the operator. A built-in electric brake provides instantaneous motor control in either direction. Bulletin 3344-A gives full details and capacities; write for it *now*.

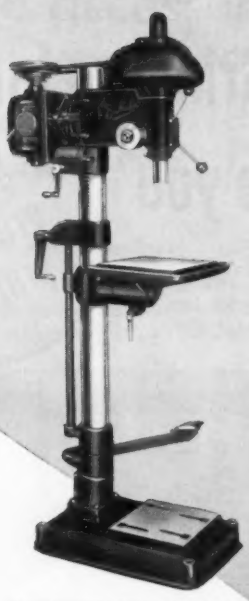
**EXTREME SENSITIVITY** – plus rugged, dependable construction make the "Buffalo" No. 16 Drill ideally suited to a wide variety of aircraft operations. Your choice of 8 inch, 12 inch and 15 inch overhang — bench, floor or pedestal types — multiple units up to 6 spindles. You can order the "Buffalo" No. 16 Drill with power feed, motor-reverse tapping and many other special variations. Write for Bulletin 2730G.

**A HIGH GRADE DRILL** – the No. 18 is easy to operate. Combining good sensitivity with rigid, durable design at a moderate price, it will perform a broad range of production and shop applications in the aircraft field. Suitable for general work up to 1 inch cast iron. Nineteen models available in bench and floor types, with multiple units up to 6 spindles in pedestal model. Write for full details on the "Buffalo" No. 18 Drill — ask for Bulletin 3123E.

The "Buffalo" Machine Tools on these pages — like *all* "Buffalo" products — feature the famous "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.

**BUFFALO FORGE**

Canadian Blower & Forge



"Buffalo" No. 18 DRILL

# machine tools quality standards

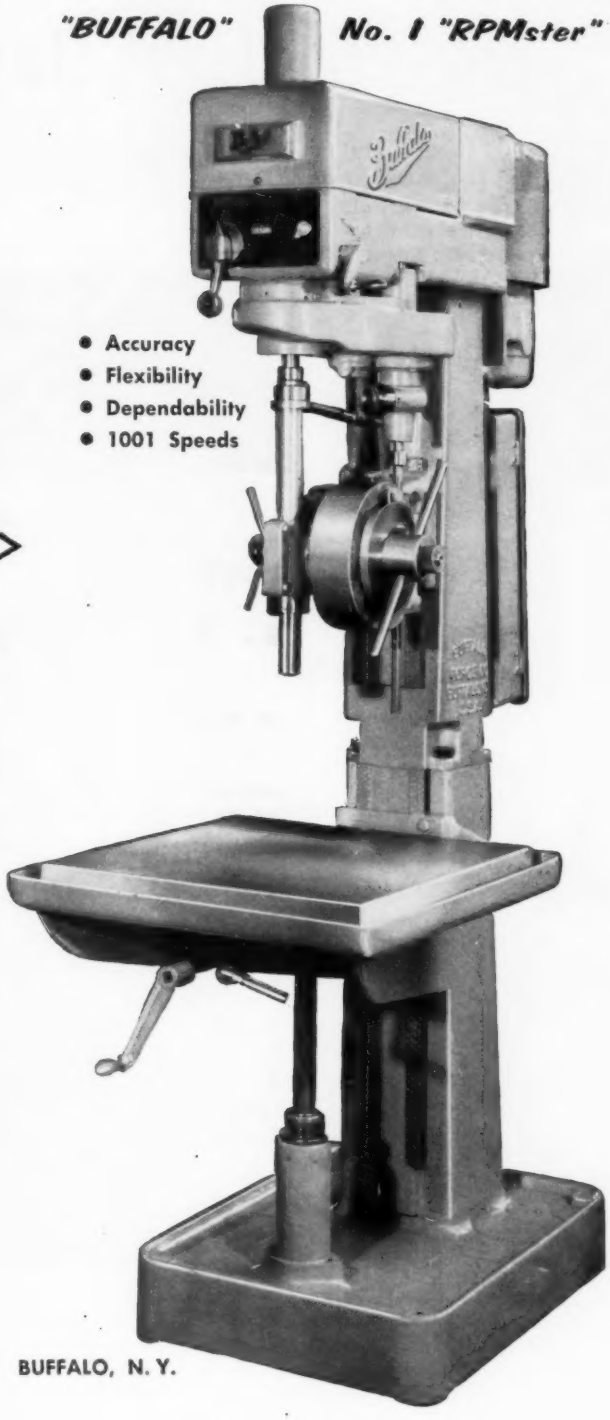
The "Buffalo" No. 1 "RPMster" is the ultimate in drilling machines for the aircraft builder. It has achieved industry-wide fame for its quick-change variable speed drive, its accuracy, durability and versatility.

Outstanding "RPMster" features are the clean, streamlined design — the neatness and accessibility of all controls — the vibration-free operation — the fine balance of the drive. The two handles at the front of the head assure easy speed changes, infinitely variable throughout both high and low ranges. Not until you've tried the "RPMster," will you know what smooth and vibration-free drill operation you can command. Call your nearest "Buffalo" Representative for a demonstration — or write for Bulletin 3967-A.

**COMPANY** 440 BROADWAY · BUFFALO, N. Y.
Co., Ltd., Kitchener, Ont.

## FAVORITE OF THE AIRCRAFT INDUSTRY

"BUFFALO" No. 1 "RPMster"

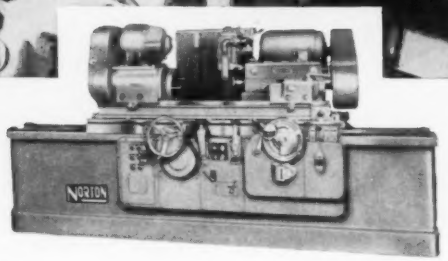


- Accuracy
- Flexibility
- Dependability
- 1001 Speeds

# Norton Type CTU Cylindrical Grinders knock out production lags . . . to give you

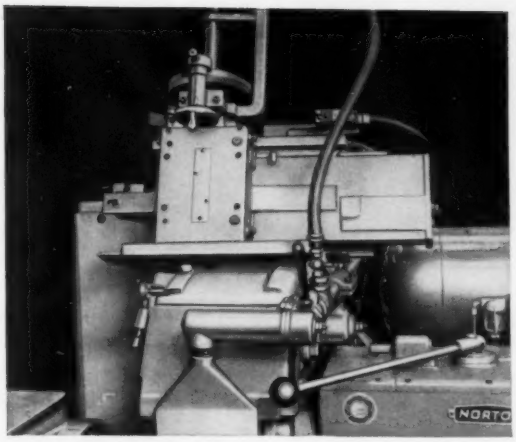
bigger grinding profits

Standard Norton Type CTU Semiautomatic Grinders in 4″ to 14″ swings have the features you need to raise your profits. Automatic accessories for wheel truing, work loading and many other functions are available to further reduce manual effort and operator attention.

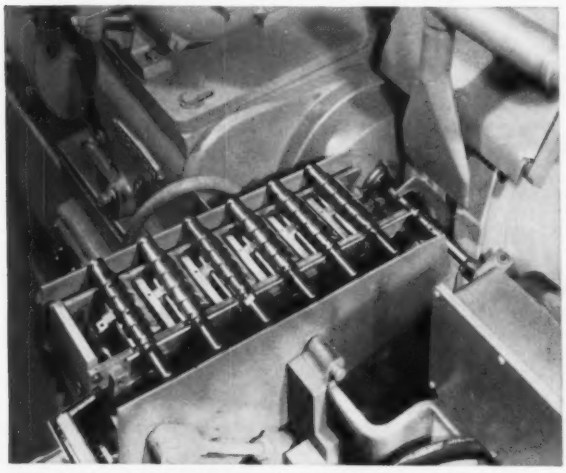



**This 10″ Norton machine** is one of the CTU family of general purpose and semiautomatic precision cylindrical grinders — top performers in anybody's book. They lick production lag with a unique combination of speed, accuracy, flexibility and durability. Production line and job shop users report that Norton CTU's have doubled production, replaced several machines, eliminated extra operations. Write for Catalogs 531, 1488 and 1787.

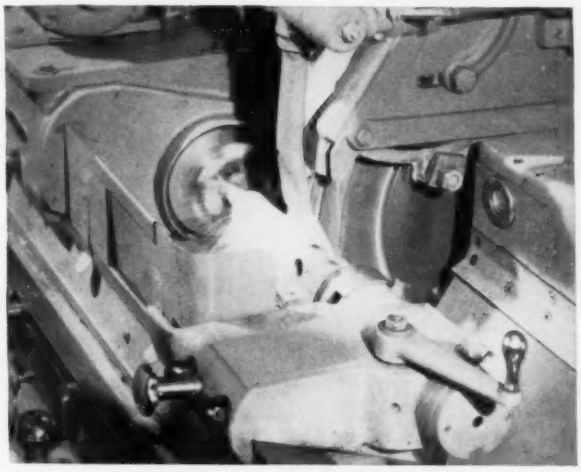
# *These accessories boost your profits... give you the "Touch of Gold"*



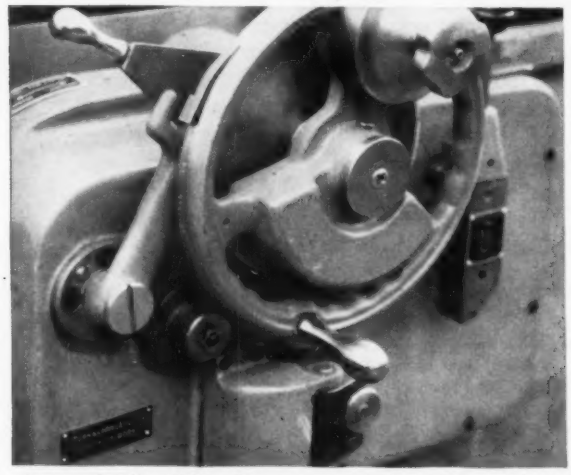
**Automatic Truing** knocks out time delay of manual operation. Abrasive and diamond savings provide an added "Touch of Gold."



**Fast Automatic Loading and Unloading** through precise mechanical means. You rule out production lags from worker's fatigue and enable your operators to attend more than one machine.



**Automatic Wheel Contact Accelerator** reduces over-all cycle time and speeds production. You never "grind air" because wheel head movement adjusts to grinding rate only after the grinding wheel touches the work.



**Automatic Wheel Wear Compensator** eliminates interrupted production. It compensates for reduced wheel diameter by resetting the wheel head at each truing — whether or not operator is present.

Norton CTU Grinders and Accessories are sound investments for increased profits. They can raise your production by 100%. Remember: only Norton offers you such long experience in both grinding machines and grinding wheels to help you produce more at lower cost. NORTON COMPANY, Machine Division, Worcester 6, Massachusetts.

***To Economize, Modernize with* NEW**

**NORTON**

**GRINDERS and LAPPERS**

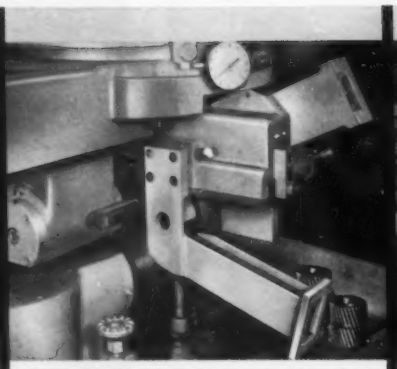
Making better products . . . to make your products better

**NORTON PRODUCTS** Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — BEHR-MANNING DIVISION Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

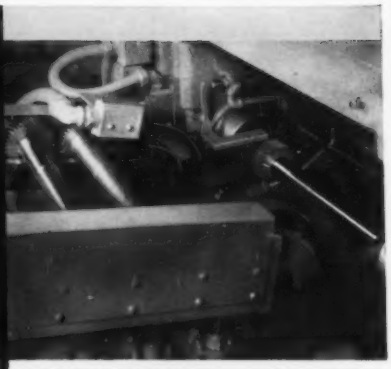
District Offices: Worcester • Hartford • Cleveland • Chicago • Detroit

**For more information fill in page number on Inquiry Card, on page 197**

*INTERNAL 870-C, only vertical internal shaver where a heavy mass (chuck and gear) drives the cutter. Reversals impose no abnormal loads on cutter teeth. This prevents excessive cutter breakage. Extras—plunge shaving.*



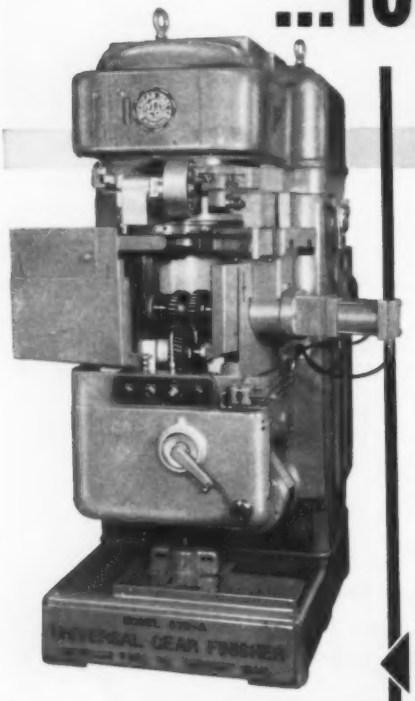
*UNDERPASS 870 Gear Finisher for fastest shaving—long or short run—of spur, helical, herringbone or shoulder gears. Extras—the new knee, new cutter-saving drive, crowning cutters, easy to set up and operate.*



*READILY AUTOMATED—Michigan 870 and 870-A shavers can be partly or fully automated. They are the only vertical shaving machines featuring 'straight-through' automation. They can be automated to load or unload from front or back.*

# TO GET BETTER GEARS AT LOWER COST

# ...look for the extras




Michigan's latest 870-series Gear Finishers are loaded with EXTRAS. A new knee assembly brings all controls to the front—and puts the operator closer to the work. Operators like ease of setup, vernier and dial locating, and the simple locking. Work located above cutter makes manual loading safer, automatic loading easier. Machine ways are up out of the way of contamination by chips or foreign matter. Timken bearings, extra-rugged fully splined shafts and a shock-absorbent drive, provide a sturdy no-backlash drive. Starts and stops are cushioned to keep cutters operating longer. Every installation has the EXTRA of being individually Michigan Application Engineered to cut costs.

*Write for descriptive literature.*

*UNIVERSAL 870-A (with new knee) permits adjustable automatic upfeed to be used with any of the three basic shaving methods. Extras—faster approach, longer tool life. Optional crown shaving attachment (permits shaving of a series of gears with varied crowns using only one tool).*

May we have the Michigan Tool engineering representative in your area show you how Michigan gear finishing can make your geared parts even better.

MICHIGAN TOOL Company

from blank to finished gear

7171 E. McNICHOLS RD., DETROIT 12, MICH., U.S.A.
IN CANADA: COLONIAL TOOL CO. LTD.

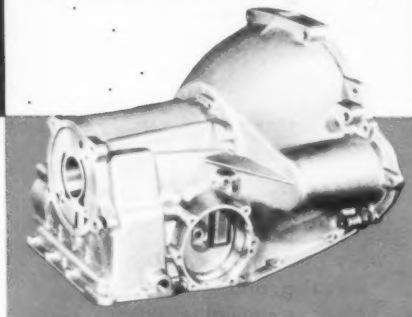


For more information fill in page number on Inquiry Card, on page 197

# EX-CELL-O Precision Production News

COST-CUTTING IDEAS FROM EX-CELL-O CORPORATION — DEVOTED TO MINIMIZING COST OF PRODUCTION

Over-all view of 24-station, 75-foot long transfer machine looking from loading end. A typical high production automation machine by Ex-Cell-O.



Aluminum automobile transmission case after automatic precision boring, tapping, precision fly cut milling, gaging and flushing on Ex-Cell-O Transfer Machine.

58-31A

## 120 parts per hour —automatically!

**24-station transfer machine performs multiple machining of automotive transmission housings in high-speed, automated production . . .**

At the touch of a button, this Ex-Cell-O Transfer Machine turns aluminum castings into finish-machined automatic transmission housings at a rate of *one every 30 seconds.*

From its first-station loading, through complex machining operations, to its unloading section 24 stations later, this 75-foot-long unit produces labor savings, time savings and precision parts —automatically.

Machining steps include semifinish-and-finish facing, precision boring at five different stations, tapping and precision fly cut milling. Air gages monitor all boring operations and parts are oriented automatically—turned 90° for boring at one station, inverted 180° at another for milling on four surfaces.

Ex-Cell-O Transfer Machines may be the high-production answer to your manufacturing problems. See your Ex-Cell-O Representative, or write direct for further information.

**3 MORE COST-CUTTING IDEAS**

# The precise answer to higher production

**When product demand goes up, versatile Ex-Cell-O Duplex Machines answer the problem of supply**

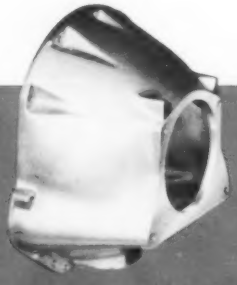
A large auto manufacturer recently increased production of torque converter housings *automatically* by using three Ex-Cell-O Style 432 Duplex Vertical Boring Machines.

Two double-station machines finish-face the engine-mounting end of the cast-aluminum housings, and semi-finish the opposite face. The third machine is tooled to finish-face the transmission-mounting end and to bore and chamfer a 7.003″-7.006″ hole.

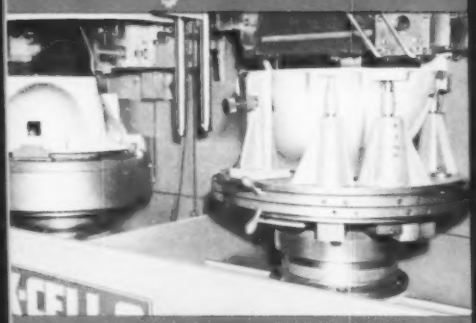
Ex-Cell-O Duplex Machines also perform such operations as precision turning and grooving; stations can be operated independently for different parts and operations, or set up for identical operations.

Find out how Duplex versatility can increase precision production in your plant: Call your local Ex-Cell-O Representative today, or write direct.

58-318

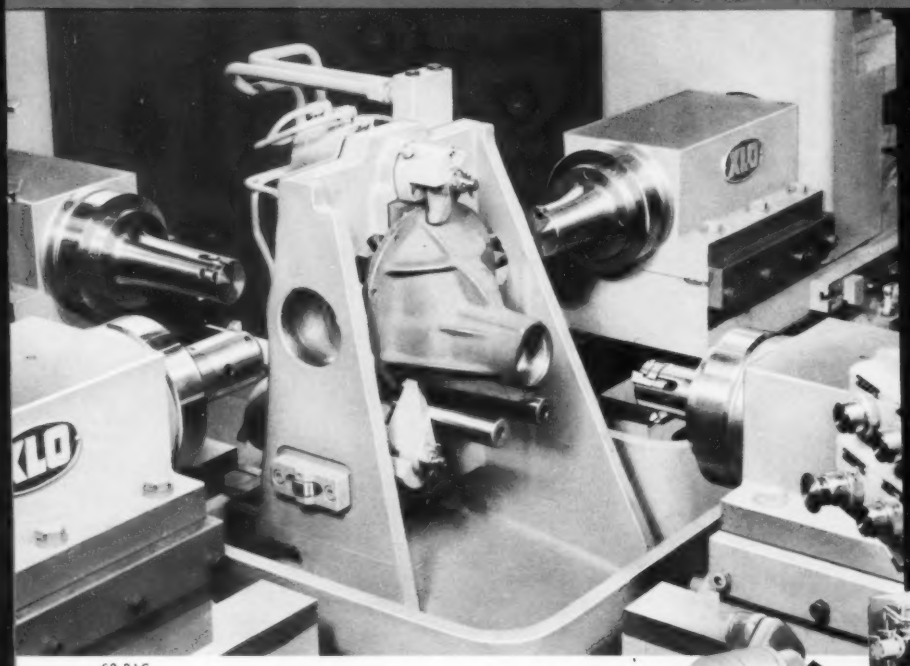


**Aluminum torque converter housing, shown after machining, is completely roughed and finished at both ends and chamfered and bored by three Style 432 Duplex Vertical Machines.**



**Above: At station 1 (left) part is semi-finish-faced on the transmission end by one tool; at station 2, the engine-mounting end of the part is finish-faced by two tools making a single pass.**

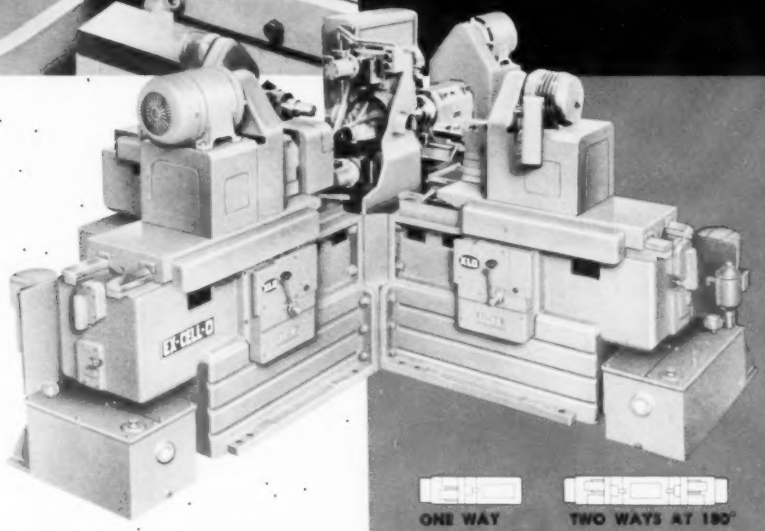
***Right:*** **Duplex Vertical Boring Machine is used for high-volume production of automatic transmission housings. Style 432 performs various machining operations alone or in any combination.**



Close-up of 4-way machine shows Ex-Cell-O Precision Spindles used to assure accurate boring of pinion bearings and cross-holes in an automotive differential housing.

*Below:* Working simultaneously from four directions, this Ex-Cell-O Way-type Machine is made up of four standard units joined with a standard center section for precision location of the workpiece and precise 90° relationship between spindles.

58-31C



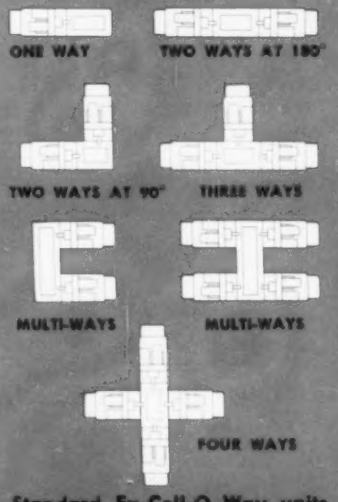
# Operations Combined to Boost Profits

**4-Way Precision Boring Machine works simultaneously from 4 directions for fast, accurate production**

The differential carrier assembly above is typical of parts machined quickly, easily and economically on Ex-Cell-O Way-type Machines. On this particular job, bore relationship is maintained at a true 90° and bore diameters are held as close as .0005".

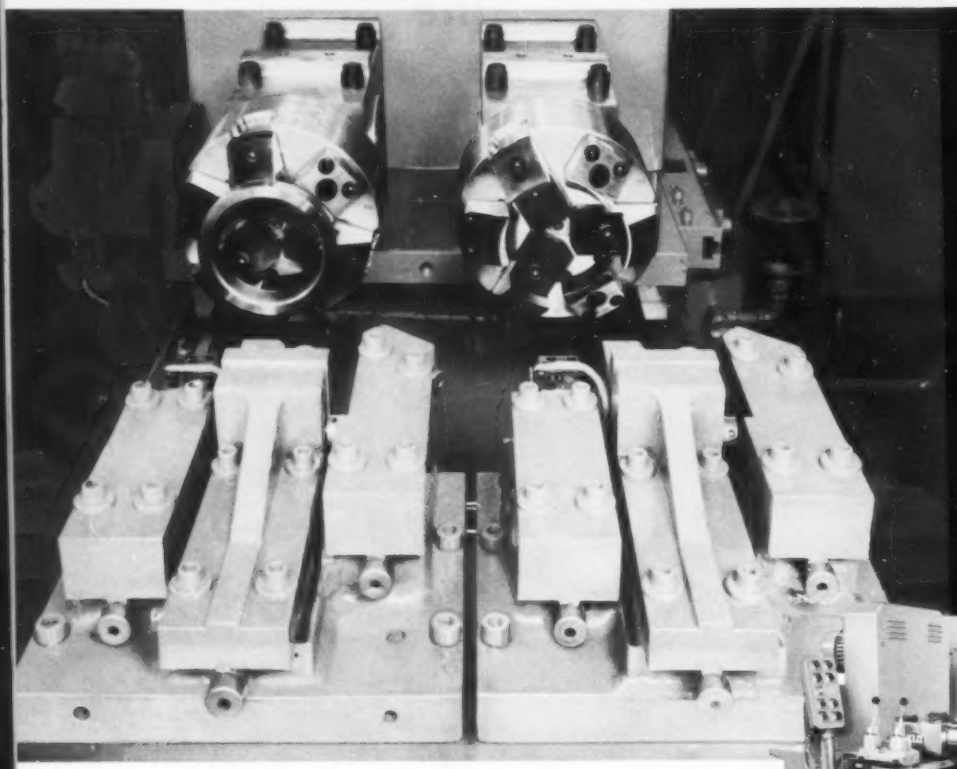
Ex-Cell-O Way-type Machines consist of standard units combined into a single machine with a standard center section for precise, simplified parts location. They can be used singly or utilized in fully automated lines.

If your production plans—present or future—demand utmost accuracy with high output, look into the many advantages of Ex-Cell-O Way Machines by calling your local Ex-Cell-O Representative today or, if you prefer, by writing direct.

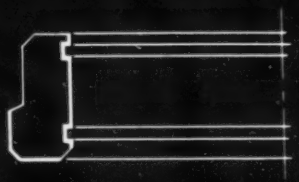



**Standard Ex-Cell-O Way units can be combined in these combinations for precision boring, turning, facing, grooving and chamfering.**

# EX-CELL-O PRECISION PRODUCTION NEWS



*Left:* In this Style 312 three individually adjustable tool blocks at each station hold grooving tools, boring tool and a tool for facing, chamfering and turning operations.



*Above:* Machining steps are shown by heavy lines on cross-section drawing. Below: This Style 312 is also suited to the intricate contour-machining required in aircraft and missile development.

## More Operations—

## FASTER!

**Cam Boring Machine precision faces, chamfers, turns, bores and grooves 140 steel transmission races per hour**

A two-spindle Style 312 Cam Boring Machine is combining precision with high volume production of steel transmission races made by a major automobile manufacturer.

Air-operated chucks hold the parts in the spindles. Two sets of tools—four tools in each set—are mounted on the cross-slide. The first tool faces, chamfers and turns; the second bores the I.D., holding to plus-or-minus .001" tolerance. Tools three and four plunge the two grooves, radiused to .010". Critical dimensions are held to close limits on all machining cycles.

The precision-built Style 312 is particularly suited to the intricate contouring required by aircraft and missile components.

Your Ex-Cell-O Representative can provide full details, or write directly to Ex-Cell-O.

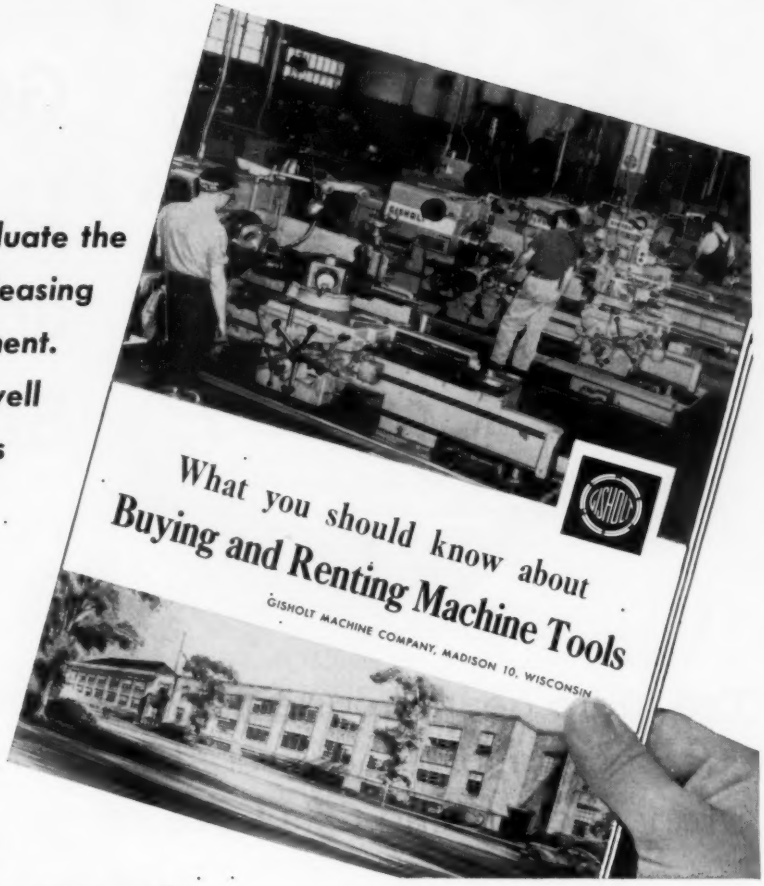
**EX-CELL-O**
**CORPORATION**
**DETROIT 32, MICHIGAN**

XLO
EX-CELL-O FOR PRECISION

MANUFACTURERS OF PRECISION MACHINE TOOLS GRINDING AND BORING SPINDLES • CUTTING TOOLS TORQUE ACTUATORS • RAILROAD PINS AND BUSHINGS DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

# Can your competitors turn metal at lower costs?

***Now** is the time to re-evaluate the possibilities offered by leasing of new production equipment. Your decision today can well determine your company's position in tomorrow's competitive market.*




## This free booklet tells how you can get new machines with minimum capital outlay

If you have delayed replacing old machines because of the relatively large capital investment, acquisition by methods other than outright purchase may solve your problems. Only a minimum initial investment provides you with the many competitive advantages that new machines offer, including greater accuracy, higher production rates and faster setup. New features and accessories simplify even the toughest jobs. Secondary operations are minimized and spoiled work becomes a thing of the past. All this means lower unit cost—more profit for you.

If you want the benefits that new machine tools can provide, and if you like the idea of letting them "pay their way" while they "turn" a profit for you, you'll want to write for Gisholt Bulletin 1173 on buying and renting machine tools. It fully explains one of the most liberal and comprehensive policies in the industry, and covers several types of leasing and time payment plans with vital information on depreciation, tax angles, the MAPI formula and other timely questions. The coupon will bring your free copy. Send it along today.

**GISHOLT MACHINE COMPANY**
**Madison 10, Wisconsin**

**ASK YOUR GISHOLT REPRESENTATIVE ABOUT FACTORY-REBUILT MACHINES WITH NEW-MACHINE GUARANTEE**

Gisholt Machine Company
1209 E. Washington Ave.
Madison 10, Wisconsin

Without obligation, please send your Bulletin 1173.

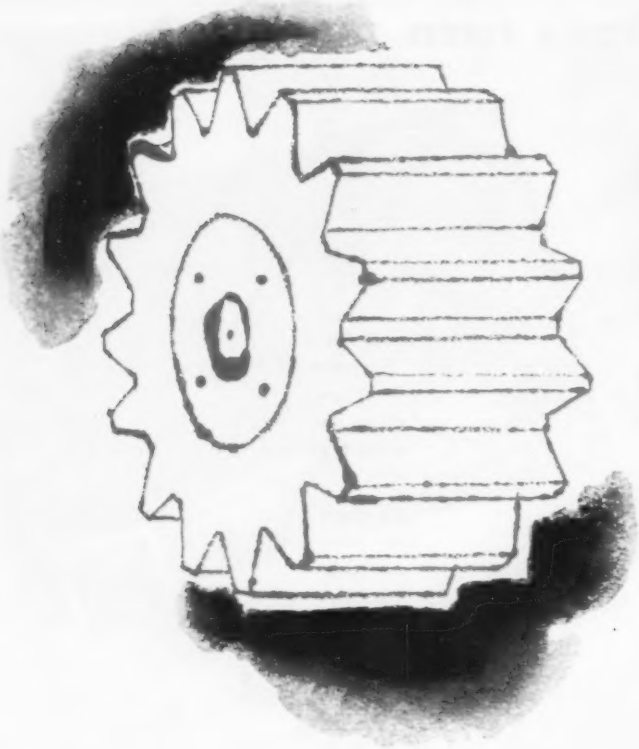
*Name*.....*Title*.....

*Company*.....

*Street address*.....

*City*.....*Zone*.....*State*.....

For more information fill in page number on Inquiry Card, on page 197



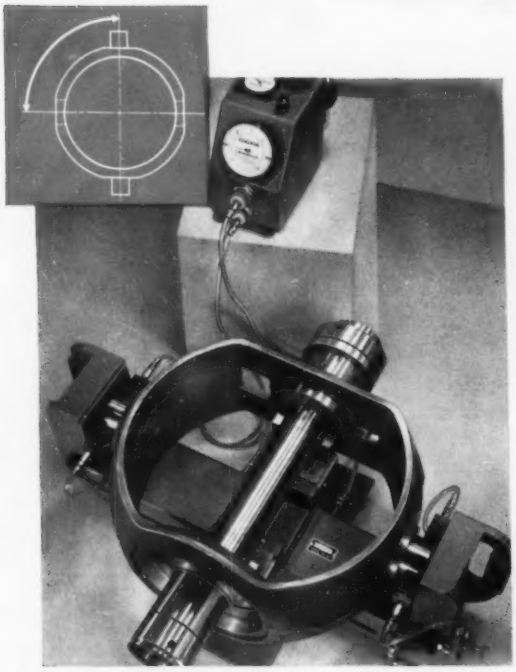
# Gears... Cutting Oils... and How to Save Money

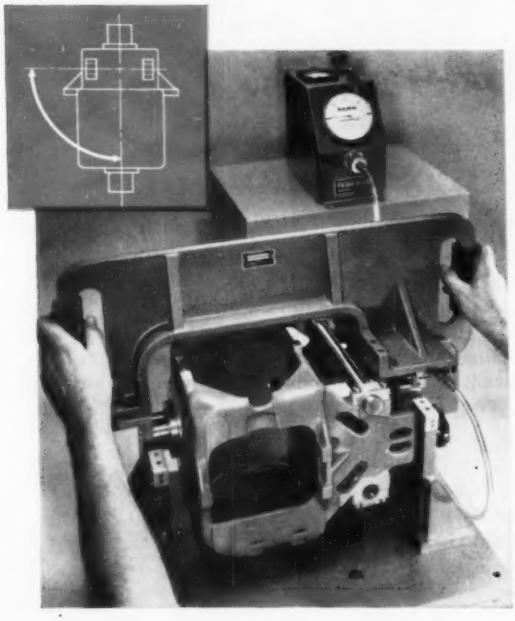
The more gears your equipment can hob before tool change, the lower your cost of operation. Sinclair Ordnance Cutting Oils have earned the reputation for increasing tool life because of their high heat dissipation characteristic. Furthermore, a special E.P. agent assures the highest quality finish . . . more money saved through fewer rejects. Switch to Ordnance, now. Next time management asks how you've cut costs, tell them you've changed to Sinclair—and show them the results.

**Call your Sinclair Representative** for further information or write for free literature to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. There is no obligation.

**SINCLAIR**
**Ordnance Cutting Oils**

# GUIDANCE IS CRITICAL





## ...SO IS THE GAGING!

When you're striving for perfection in the heartbeat of the missile, you must determine dimensional conformance of the components — *without question.* Long experience in solving critical gaging problems has equipped Federal to provide missile manufacturers with the high-reliability precision gaging that is so essential.

Wherever you have a gaging need — whether it involves guidance components, or any other precision parts, let Federal's experience on other missile programs* help you. To learn more, send for the new brochure "Precision Gaging For Missile Production."

Air gage and cradle fixture check guidance gimbals of surface-to-surface missile for squareness of pivot axis to bore axis, one of many critical measurements required. Bores locate on precision mandrel resting in V-blocks. AirProbe contacts shift position if any deviation from 90° relationship occurs. Corresponding change in balance of air meter is easily read on dial graduated in .00005" which spreads out tolerance (±.0005" in 20") over half the dial.

Platform which rides in the gimbals shown in other illustration also has numerous critical relationships, one of which is being gaged here. The axis of the platform pivots must square within .0005" in 20" to the axis of the bores in which gyros will mount. V-blocks in portable C frame fixture locate on pivots of platform held in special cradle. AirProbe contact responds to any lack of squareness. Amount shows up on air gage dial graduated in .00005".

* FEDERAL has provided precision gaging for:

| | |
|---|---|
| ATLAS | FIREBEE |
| BOMARC | MATADOR |
| CORPORAL | NAVAHO |
| DART | NIKE |
| FALCON | SPARROW |
| THOR | |

**FEDERAL PRODUCTS CORPORATION**
**8117 EDDY STREET PROVIDENCE 1, R. I.**

*Ask* **FEDERAL** *First*
**FOR RECOMMENDATIONS IN MODERN GAGES...**
Dial Indicating, Air, Electric, or Electronic —
for Inspecting, Measuring, Sorting, or Automation Gaging

# Operates MARVEL No. 8 Metal Cutting Band Saw by FEEL!

## sightless operator uses saw to FULL CAPACITY!

Among the many advantages of the MARVEL No. 8 Band Saw is the simplicity and convenience of operation built into this universal metal cutting saw.

Here's a case in point. Paul Stevens, who is totally blind, is employed by the Purkett Manufacturing Co., Joplin, Mo., manufacturers of laundry equipment, as a MARVEL No. 8 Band Saw operator. He operates two MARVEL No. 8 Band Saws, filling orders from the fabricating department for bars, shapes and even mitres. He handles the entire operation without assistance from anyone.

Thoroughly familiar with his stock and bin locations, he sets up the saw, measures lengths, and turns out work accurate to $\frac{1}{32}$". Almost any conceivable sawing job is handled on these machines, from the smallest, most delicate work to heavy beams, up to 18". They will cut-off bar stock, pipe, tubing, moulding and structural shapes—saving hours of machining time.

The MARVEL No. 8 vertical column design, table height working surface, easy accessibility to simple operating controls, fast and positive power or manual feed control, column and blade tilting to any angle up to 45° right or left of vertical for cutting at an angle or mitre—are just a few design and operating features that make MARVEL No. 8 Band Saws the best all-around saw you can buy.

*For the complete story, write for the new Bulletin 875, which illustrates and describes this outstanding universal metal cutting saw.*

**ARMSTRONG-BLUM MFG. CO.**
5700 BLOOMINGDALE AVENUE, CHICAGO 39, ILLINOIS

For more information fill in page number on Inquiry Card, on page 197

Spur gear

Index plate

Retaining ring

# How one machine hardens them all *without distortion*

You can quench any part quickly from a hot, plastic state without warpage or distortion when you work with Gleason Quenching Presses.

Since no straightening operation is necessary after hardening you save time and make a definite advance in quality control. Experience shows there is much less residual stress in non-straightened parts.

A button is pressed and the automatic quenching cycle is started. The lower die is swung back into the quenching position and the upper die descends rapidly, aligning the part while it is still in the plastic state.

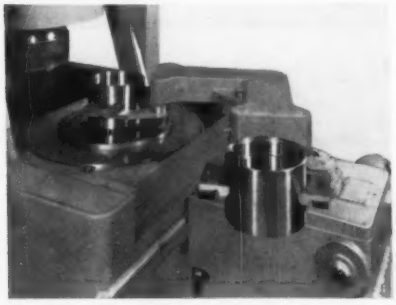
Carefully controlled metallurgically correct oil circulation cools and hardens the part uniformly to preset rates.

The two dies align the part throughout cooling, allowing the part its normal contraction but keeping it true. After the quench, the part is swung out for removal.

As shown in the photograph at the left, Gleason Quenching Presses can be arranged with a completely automatic load and unload unit.

You can harden *any* part, regardless of shape, with this method. There are three presses accommodating parts up to 36″ diameter. Still another Gleason Press automatically hardens and straightens shafts and similar parts up to 4″ in diameter and 40″ long.

Write for literature on the presses. And for recommendations on the press and dies that best fit your products, send us blueprints.



*The Gleason Nos. 16 and 26 Quenching Presses can be arranged with the load and unload unit. This unit makes it possible to speed production and reduce labor requirements.*

**GLEASON WORKS**

*Builders of bevel gear machinery for over 90 years*

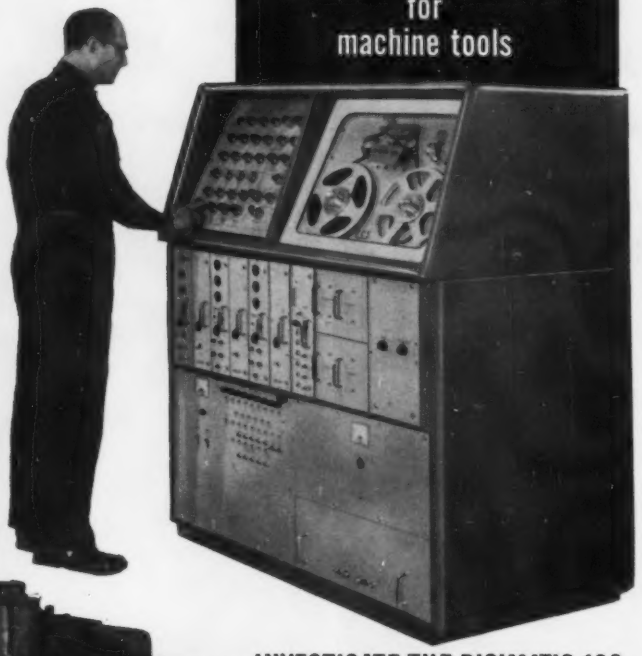
1000 UNIVERSITY AVE., ROCHESTER 3, N. Y.

cs

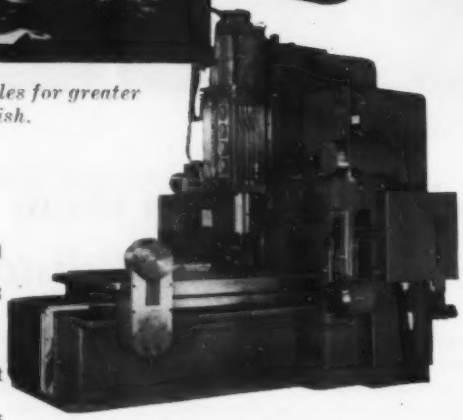
# Reduce Costs Increase Efficiency

# DIGIMATIC

contour control system for machine tools



**EXCLUSIVE!** *Cuts true circles for greater accuracy and smoother finish.*



**FAST...**
- 3½ hours from blueprint to finished piece... for a typical part.
- Director prepares ½" tapes at 8 times cutting rate.

**ACCURATE...**
- Closed loop servo provides constant check on position.
- Automatic slow-down on inside cuts prevents over-shoots.

**ECONOMICAL...**
- Lowest cost control system, both in purchase price and in operating expense.
- Keyboard "Programming" by machine shop personnel.
- Eliminates cost, maintenance and storage of "hard" tooling.
- Shortens lead times and reduces first-part cost.

## INVESTIGATE THE DIGIMATIC 180 MILLING MACHINE CONTROL!

It's the lowest priced, easiest to operate high-performance contour control system you can purchase today. Commercial deliveries are now being made.

Control illustrated is now in use at Convair-San Diego. This is the first of fifteen DIGIMATIC 180's combined with Morey A50 contour milling machines being delivered to Air Force contractors.

Provides three-axis coordinated control with 100-inches per minute (max.) cutting rate. (±0.001 inch tolerance.) Compact: 48" wide x 35½" deep x 61" high.

DIGIMATIC Controls are now available on a number of well-known machine tools in a variety of sizes.

*Write for 16-page, illustrated Brochure giving complete details and specifications.*

ECS

**ELECTRONIC CONTROL SYSTEMS**
Division of
**STROMBERG-CARLSON COMPANY**
A DIVISION OF GENERAL DYNAMICS CORPORATION
2231 South Barrington Avenue, Los Angeles 64, California



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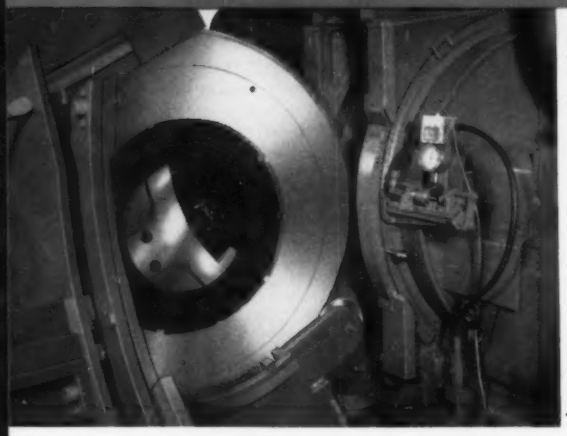
# precision grinds parallel faces of large aircraft brake discs



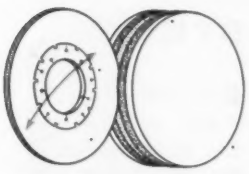
**TWO** parallel surfaces ground in **ONE** operation

## . . . production paced by automatic cycling
## . . . tolerances checked by automatic gaging

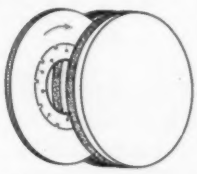
Close limits of flatness, parallelism and uniformity are held by 2H30 Double Spindle Precision Disc Grinder in large area grinding operation. (left) Swinging arm fixture handles discs of different diameters.

**production data**

| | |
|---|---|
| Machine | Gardner 2H30 Disc Grinder |
| Operation: | |
| | Rough and finish parallel sides of aircraft brake discs |
| Size of Workpieces | 12″ O.D. to 21″ O.D. |
| Cycle | 3 to 6½ min. each depending on size |
| Stock Removal | .062″ max. overall |
| Flatness | .002″ to .003″ |
| Parallelism | .001″ |
| Uniformity | .004″ |
| Finish | 80 RMS |



*Loading position—swinging arm*



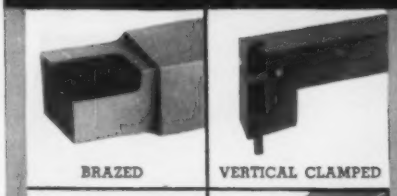
*Grinding position—fixture rotates*

# GARDNER

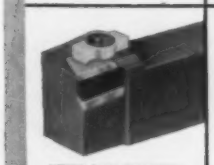
**precision disc grinders**

BELOIT, WISCONSIN

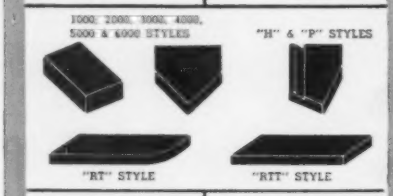
# Caterpillar REG. U.S. PAT. OFF. Tractor Co. gets results . . . with Talide S-92

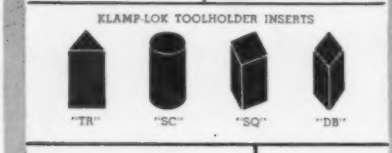

BRAZED

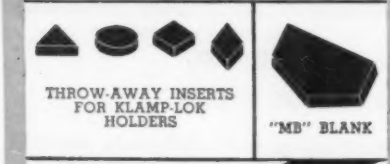

VERTICAL CLAMPED

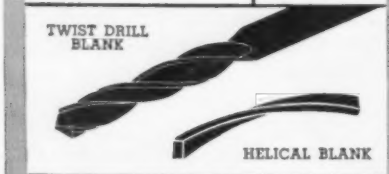

"THROW-AWAY"

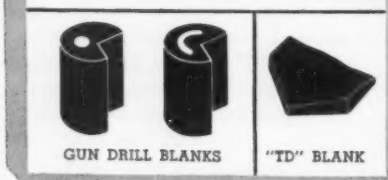
HORIZONTAL CLAMPED

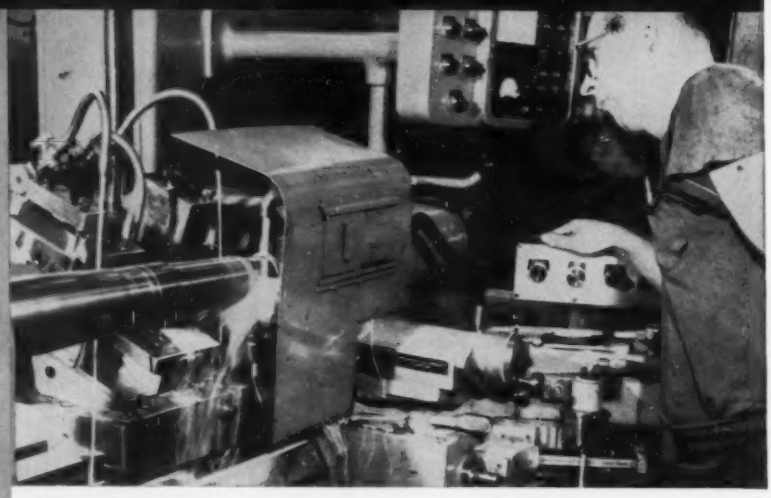




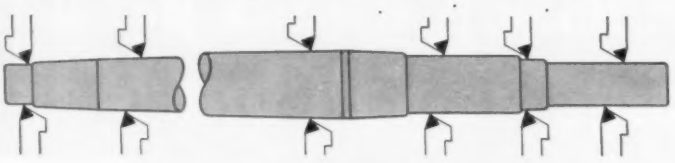



Caterpillar REG. U.S. PAT. OFF. Tractor Co., leading producer of tractors, diesel engines, motor graders and earthmoving equipment, has been using cost-cutting TALIDE tools for over 10 years to produce parts. Typical example of savings obtained is illustrated below:



## CRAWLER TRACTOR AXLE SHAFT

**Part** . . . . . Crawler Tractor Axle Shaft

**Material** . . . . . SAE 8645 Steel Forging 3¼" dia. x 38½" long, 3.6mm Brinell Hardness.

**Operation** . . . . Rough turn all diameters, form tapers, shoulders, and steps.

**Machine** . . . . . Monarch Mona-Matic No. 21 Tracer Lather, size 54".

**Tools** . . . . . 12 Talide TB-164 ½" I.C. Triangular TALIDE Throw-Away Inserts mounted in Klamp-Lok Toolholders, Grade S-92.

**Depth of Cut** . . ⅜".

**Feed** . . . . . 6" per min.—.018 F.P.R.

**Speed** . . . . . S.F.M. 387—R.P.M. 340

**Coolant** . . . . . Soluble Oil and Water

**Results** . . . . . TALIDE Grade S-92 turned 7 shafts per corner per grind for total of 42 shafts per grind. Inserts were ground an average of 6 times and produced a total of 294 shafts over life of insert. Next best premium carbide grade produced 235 shafts.

Call in a Talide sales engineer to recommend proper tooling for your machining operations, or write for 76-page catalog No. 57-G. METAL CARBIDES CORPORATION, 6001 Southern Blvd., Youngstown 12, Ohio.

**CONSTANT RESEARCH PAYS OFF!**

Year after year Talide metal improves in hardness, strength, rupture resistance and crater resistance properties. Processed in latest type vacuum electric furnaces under rigid laboratory control—all Talide grades are uniform and consistent in quality.

METAL CARBIDES CORPORATION
MC
TALIDE®
YOUNGSTOWN 12, OHIO

HOT PRESSED AND SINTERED CARBIDES • VACUUM METALS
HEAVY METAL • ALUMINUM OXIDE • HI-TEMP. ALLOYS
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY

# when TIME means the order...

These Cincinnati HYDRAGUIDE® Tracer Lathes are designed to *save time* . . . in operating, job change-over, maintenance. All controls are on the front side for maximum convenience and safety . . . just push a button for lowest-cost tracer machining, yet there is no interference with standard lathe operation. No extra floor space is required . . . everything is on the carriage, yet nothing is in the way.

And, economy-priced Cincinnati Lathes are husky and versatile enough to handle some of the jobs that often tie up heavy-duty machines.

*Do you have the new booklet, "How to Determine if a Lathe will be a Money-Maker"? See your CL&T Dealer, or write us direct.*

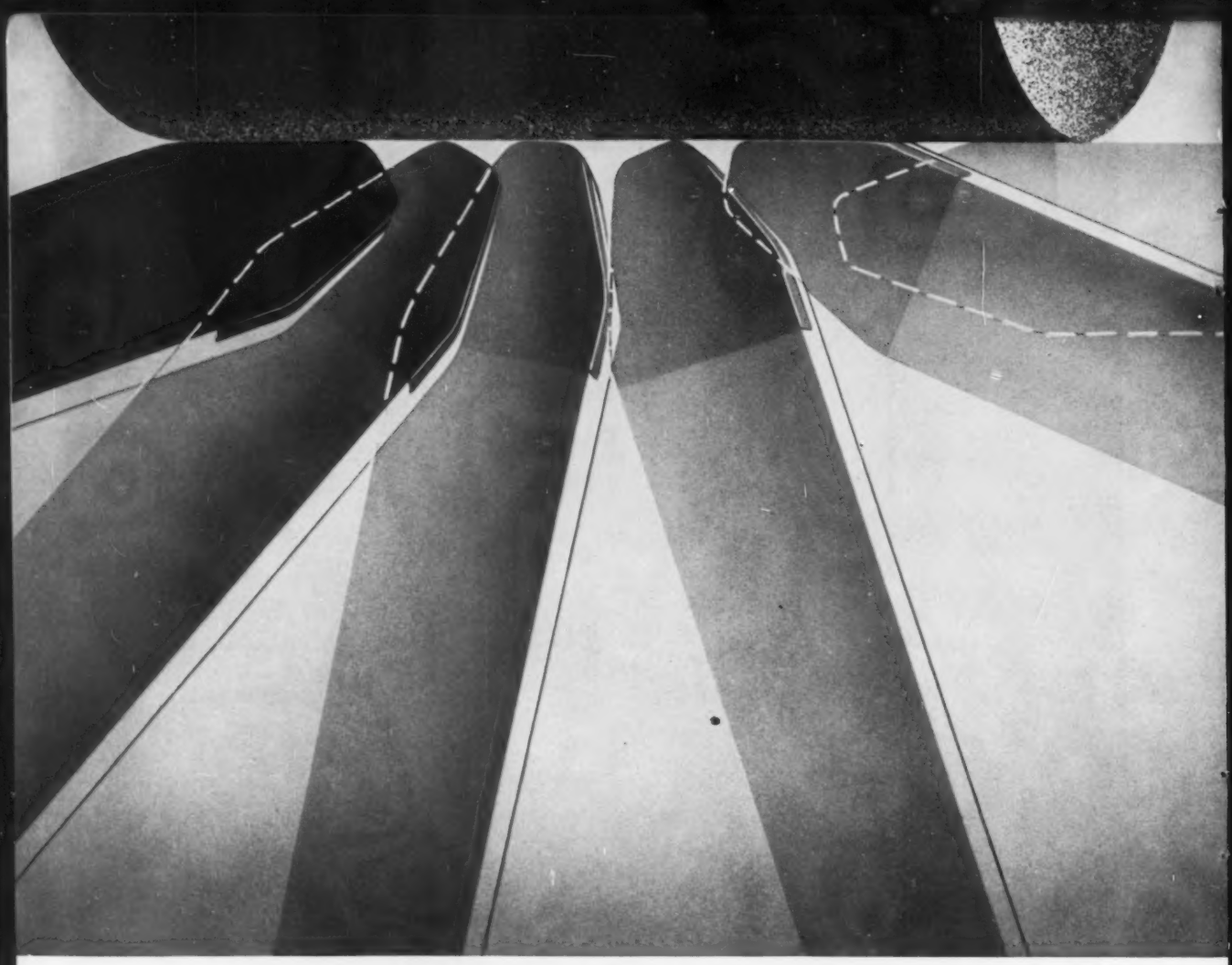
Improved Machining Through Research

CINCINNATI LATHE AND TOOL CO.

3207 Disney Street • Cincinnati 9, Ohio

*"TRAY-TOP" Lathes / "CINCINNATI" Drilling Machines / "SPIROPOINT" Drill Sharpeners*

For more information fill in page number on Inquiry Card, on page 197



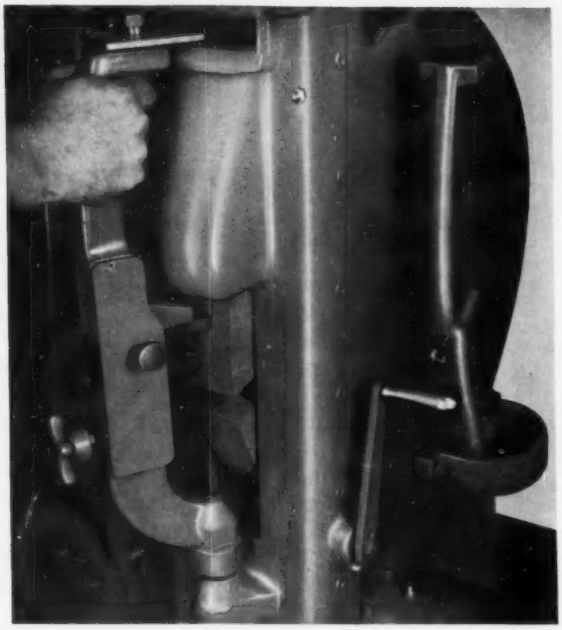
## OLIVER TEMPLATE TOOL BIT GRINDER

# Precision Duplication

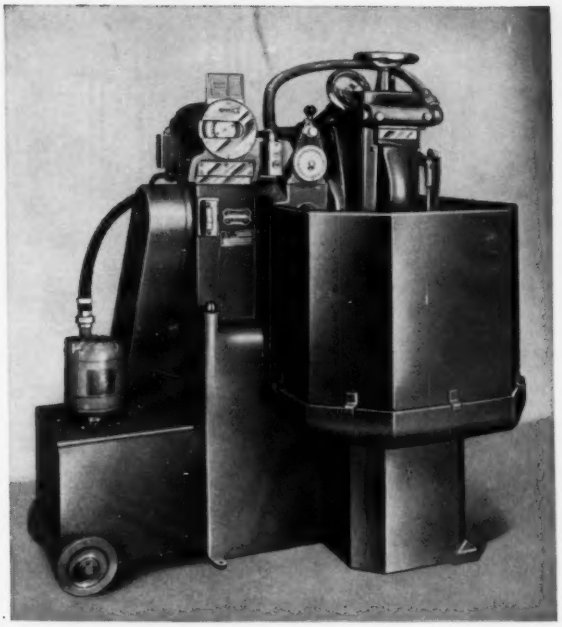
## *in* ONE *operation*

That's right! The Oliver Template Tool Bit Grinder sharpens single point tungsten carbide, high speed and stellite turning tools . . . duplicating exactly all original flats and radii every time the tool is ground . . . in one simple, efficient grinding operation.

How is it done? Well, as you can see from the drawing above the answer lies in "template control." The template at the top of the specially designed tool holder is a twice size replica of the tool being ground. The tool, securely held at mid-point in the holder, contacts the wheel and is ground until the template touches the template stop. In this manner, the tool is ground to the *exact* profile of the template. The entire operation is performed in seconds, easily, accurately on one machine . . . a machine that pays for itself by reducing your tool inventory and eliminating lost production time and tool breakage.



The Oliver Template Tool Bit Grinder has a 20″ wheel that grinds turning tools up to 1½″ wide by 1¾″ high, from 0° to 20° clearance . . . and to *any* predetermined contour or angle. The unit is self-contained in that it performs the complete grinding operation as well as template production. All working surfaces are hardened and ground steel and surfaced with tungsten-carbide where necessary to assure long life. A unique feature of the unit is the tool holder which permits an even, easily controlled tool pressure against the wheel. It's an iron frame—supported at its lower end by a ball and socket joint with a template at the upper end giving the operator a 2 to 1 leverage.



Outstanding among the Oliver Tool Bit Grinders' many advantages is ease of operation. Positive "template control" assures duplication of the tool shape in relation to the shank making all tools of a kind exactly alike. A clearance setting gauge determines the correct amount of metal to be removed. A plentiful supply of water, both through the wheel and on the tool, insures against overheating. The Oliver 20″ Template Grinder will remove metal . . . both high speed and tungsten-carbide . . . at a speed unmatched by any other single point tool bit grinder currently on the market.

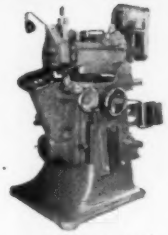
## More OLIVER of ADRIAN Tool Grinding Equipment

**ACE TOOL and CUTTER GRINDER**

Universal—grinds milling cutters, other cutting tools. Especially suited to grinding tungsten carbide.

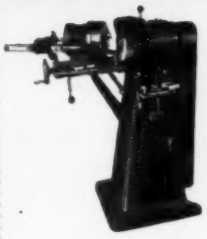
**DIE MAKING MACHINE**

Produces dies, gages, cams, templates, stripper plates, etc. at greatly reduced costs. 5 designs in 2 types.



**FACE MILL GRINDER**

Completely automatic. A machine tool designed for accurate grinding. Wheel dressed with every stroke.



**No. 510 DRILL POINTER**

Semi-automatic. For drills ¼″ to 3″ in diameter. No. 21 bench models available for size ½″ and smaller.

**DRILL POINT THINNER**

For low cost reclaiming of drills. Corrects off-center and too-thick webs and out-of-index cutting edges.

*Just check the coupon for literature on the OLIVER of ADRIAN machine you are interested in. Send it today to . . .*

**OLIVER of ADRIAN**

**OLIVER INSTRUMENT COMPANY**

1410 E. Maumee St. • Adrian, Michigan

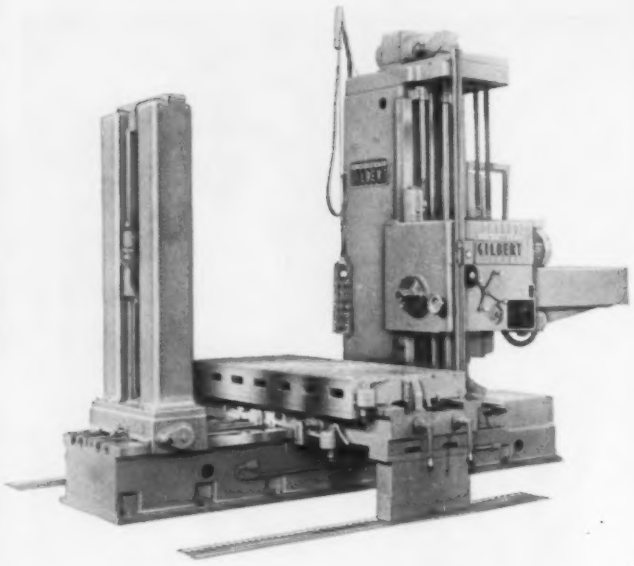
- ☐ Drill Pointer
- ☐ Face Mill Grinder
- ☐ "Ace" Universal Tool and Cutter Grinder
- ☐ Literature only
- ☐ Die Making Machine
- ☐ Drill Point Thinner
- ☐ Template Tool Bit Grinder
- ☐ Quotation requested

NAME_____

COMPANY_____

STREET_____

CITY_____ ZONE_____ STATE_____



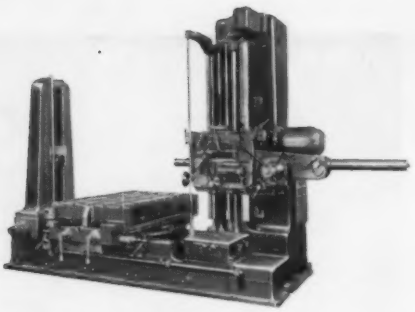
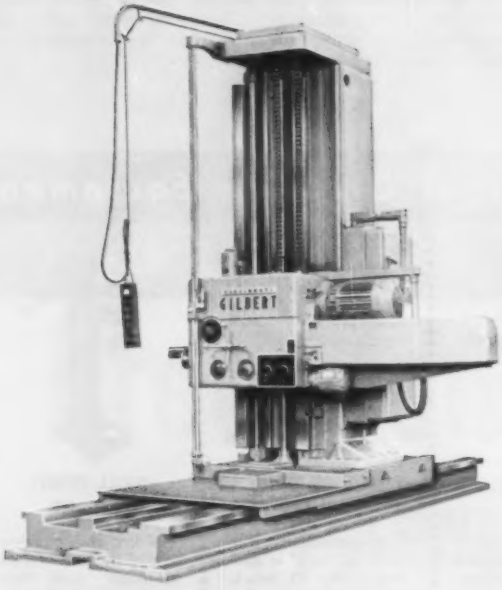
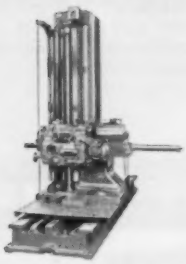



*table type*—All Gilbert table type boring mills feature built-in reversible motor, hardened spindle, anti-friction bearings throughout, hardened ways on bed, pressure lubrication, centralized controls (on pendant station or unit head).

Spindle diameters: 3½", 3¾", 4", 5". Morse taper or milling machine taper. Spindle speeds up to 1500 rpm. Variety of table sizes, column heights. Automatic positioning available with saddle supports.

## CINCINNATI GILBERT BORING MILLS



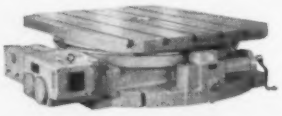



*floor type*—Many types of base plates, bases, or tables can be combined with a Gilbert floor type boring mill to make it one of the most productive tools in your plant. With a revolving column, this machine can do certain types of profiling and duplicating at a fraction of the cost of other machine tools used for this type of work.

Choice of runway sizes and column heights, plus workholding units, give you a great range of work capacity. Can be adapted to existing runways.

# GILBERT

THE CINCINNATI GILBERT MACHINE TOOL CO.
3346 BEEKMAN STREET, CINCINNATI 23, OHIO



*rotary tables*—Hand revolving, power rotary, and power-feed rotary tables available in these sizes: 36", 50", 60", 72" square and round. Special tables can be built.

*accessories*—Milling attachments, facing heads, boring bars, end measuring instruments, etc., available at competitive prices.

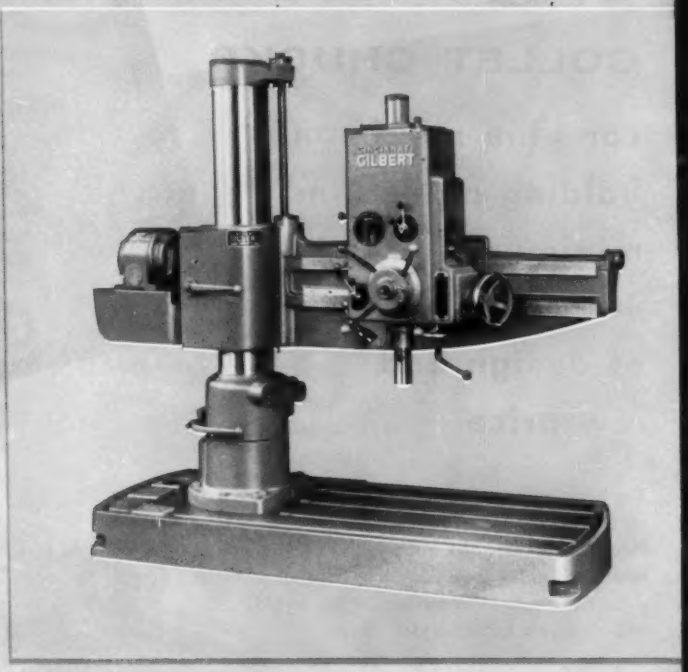
*features*—The first radials to offer flame-hardened 9″ and 11″ columns. Centralized controls, quick response, maximum work visibility cut machine-handling time. Alloy steel spindle quill has a long bearing in the head. Spindle is mounted on 5 precision ball bearings. Hardened tang slot, safety elevating nut and screw. A wide variety of bases can be furnished, or the Gilbert can be mounted on runways or rails.

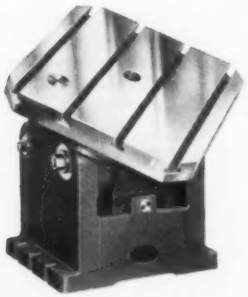
*new 3 hp radial*
Automatic spindle reverse, adjustable spring counterbalance.
Arm length: 3′ or 4′.
Column diameter: 9″.
Spindle radius from column center, max.: 42¾″, 54¾″.
Spindle traverse in head: 10″.
Morse taper in spindle: #4.
12 spindle speeds to 3200 rpm.

## CINCINNATI GILBERT RADIAL DRILLS

*5-7½ hp radial*
Arm length: 3′, 4′, or 5′.
Column diameter: 9″ or 11″.
Spindle traverse in head: 12″.
Morse taper in spindle: #4 or #5.
12 spindle speeds to 1800 rpm.
Spindle radius from column center, max.: 44½″, 56½″, 68½″.

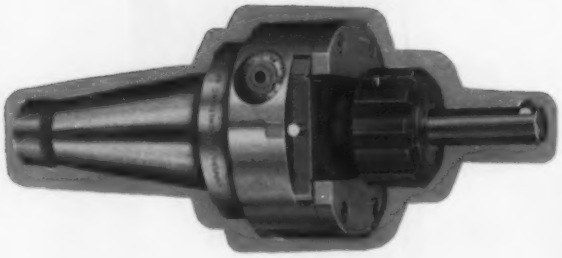
*universal table*—For use with either radial drills or horizontal boring mills, Gilbert universal tables permit machining 5 sides of a cube at one setting of the work piece. Sizes: 22″x22″ and 27″x27″ tops.



# GILBERT

THE CINCINNATI GILBERT MACHINE TOOL CO.
3346 BEEKMAN STREET, CINCINNATI 23, OHIO



**UNIVERSAL BORING CHUCK** is heavy and rigid for all types of rough boring without chatter yet accuracy of adjustment adapts it equally well to finish boring. Time-tested Universal Collet nose holds boring tool much more rigidly and securely than set screws while precision and extreme accuracy of feed-adjustment are obtained by an anti-backlash arrangement of feed screw and large dial.

# UNIVERSAL
## COLLET CHUCKS

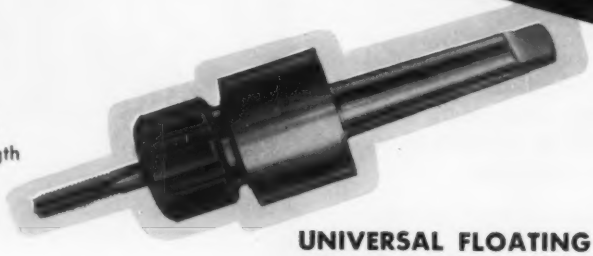
**combine maximum holding power and minimum run out with simplicity of design and low price**

The basic collet principle is the same in all Universal chucks. Tools gripped in these chucks withstand a maximum thrust and radial load because the collet grips on a continuous surface its full length and positively locks the tool. Write today for new catalog showing the complete line of Universal collets and chucks.

**UNIVERSAL RELEASING TAP CHUCK** has same basic collet principle featured in all Universal Collet Chucks. Screws or sleeves are not needed and collets are interchangeable with other Universal chucks. Simple, compact design has no springs, cams or pawls to break or wear. Can be used for either right or left hand tapping without adjustment.

**HIGH PRESSURE REVOLVING COOLANT TRANSFER CHUCK** has standard Universal Collet Chuck nose and a variety of shank sizes can be held by simply changing collets. Minimum overhang is made possible by the single face seal design. Back pressure principle of this design prevents "brake" action thus lowering torque on spindles. Chucks for higher speed and pressures than standard plus a variety of mountings are also available.

210



**UNIVERSAL FLOATING COLLET CHUCK** for horizontal or vertical operation is positively protected against destructive action of coolant by a seal which prevents entrance of compounds into interior of assembly. Frictionless ball bearing flat springs are adjustable to counter-balance weight of the tool.

**UNIVERSAL ENGINEERING COMPANY** FRANKENMUTH 2, MICHIGAN



For more information fill in page number on Inquiry Card, on page 197

# THE THOUSANDS OF HOLES

**required in the construction of the recently completed Jefferson City, Missouri bridge by Stupp Bros. Bridge and Iron Company, of St. Louis, Missouri, were all drilled by "AMERICAN" Hole Wizard Radials.**

One of the oldest and largest bridge builders and steel fabricators of the Middle West, Stupp Bros. use "AMERICAN" radials exclusively for their drilling operations. Their main reason for using "AMERICAN" exclusively is LOW COST PER HOLE.

Quick Handling—Fast Penetration—Low Maintenance are the prominent contributing factors.

"AMERICAN" Radials can be relied upon to pay excellent returns upon the user's investment.

Ask for Bulletin No. 328.

**THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.**

LATHES AND RADIAL DRILLS

*Vinson Steel and Aluminum Co.*
*Dallas, Texas says:*

Shearing capacity of this machine is 12'-0" x ½" mild steel. Note accessibility of two cranks on right end housing. Upper crank is for knife adjustment. Lower one is for back gauge adjustment.

## Adjustable Blade Clearance Allows Use of Shear for Complete Range of Thicknesses

THE feature that Vinson Steel and Aluminum Company likes best on their Steelweld Shear is the adjustable blade clearance. This permits them to use the one machine for their complete range of thicknesses. They go as low as 26 gauge galvanized material and up to ½ inch mild steel and ½ inch aluminum.

As a leading supplier of metal in North and West Texas, Vinson insists on cuts being sharp, straight and accurate. This requires that the blade clearance be correct for every thickness cut. Because of the unique easy method of adjusting the clearance on Steelweld Shears, the adjustment can be made in seconds.

Another item which is impressive is the low maintenance cost. This machine has been in service for over two years, and the maintenance has been practically nil.

More and more warehouses are installing Steelweld Shears. Usually one will handle a range of work that would require two or more other type machines not built with a fast knife adjustment feature.

***GET THIS BOOK!***

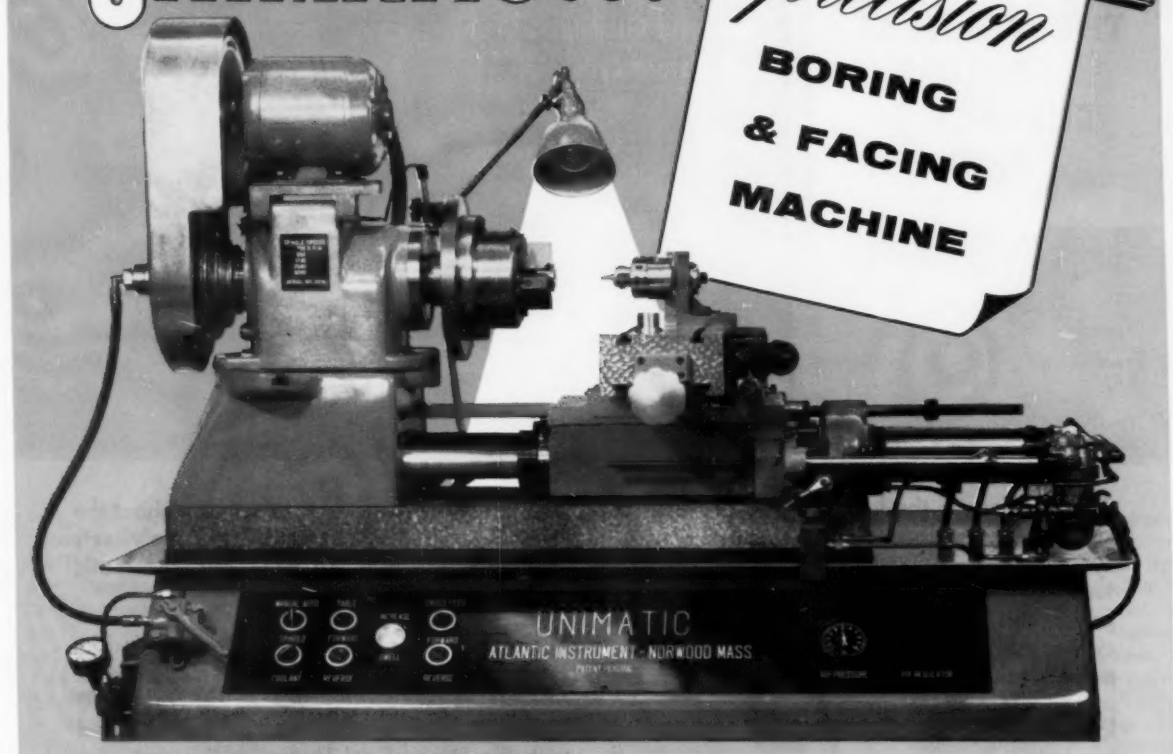
**CATALOG No. 2011 gives construction and engineering details. Profusely illustrated.**

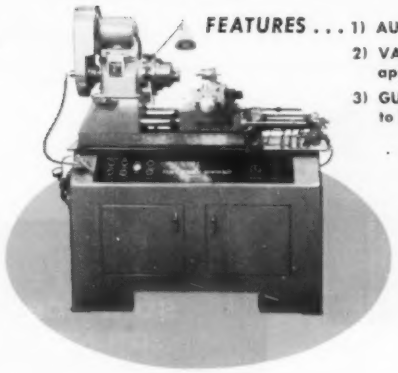
**THE CLEVELAND CRANE & ENGINEERING CO.**
5452 East 282 Street, Wickliffe, Ohio

**STEELWELD PIVOTED BLADE SHEARS**

# UNIMATIC...

**HIGH *precision* BORING & FACING MACHINE**



**FEATURES . . .** 1) **AUTOMATIC CYCLING**
2) **VARIABLE FEED approaches and returns**
3) **GUARANTEED to hold work to .0002"**

Designed and built by ATLANTIC INSTRUMENT COMPANY for their own use . . . and now offered as a type and size of machine for which there is a strong demand, especially in the instrument and allied industries, where close tolerances must be held.

*The* UNIMATIC *comprises an extremely accurate machine element, mounted on a granite base scraped to a tolerance of .00005", with other features (fully explained in our catalog) neutralizing the effects of temperature variations.*

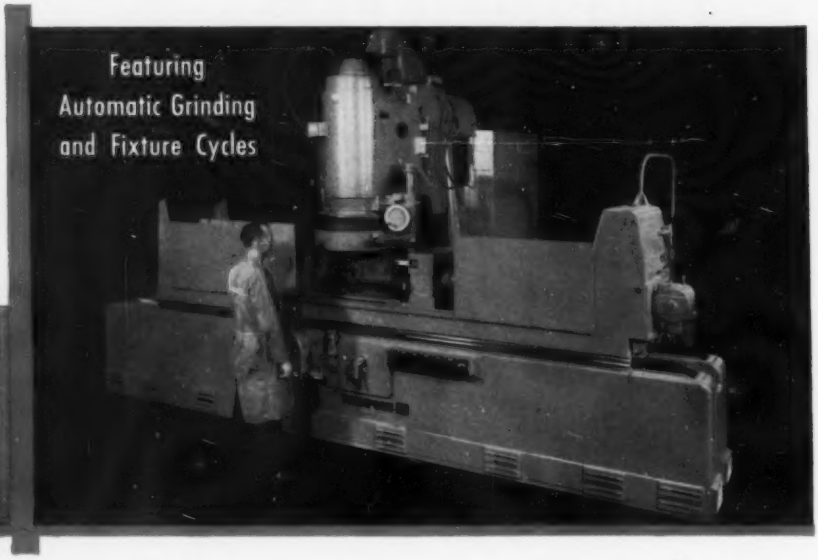
## RUSSELL, HOLBROOK & HENDERSON, INC.

**292 Madison Avenue, New York 17, N. Y.**

# THOMPSON handles the toughest production jobs... *fast and accurately...*

*with*

## THE VERTICAL SPINDLE SURFACE GRINDER




**SPECIFICATIONS**

**Size:** 18" x 18" x 62"
**Wheel:** 22" Segmental
**Production:** 30 blocks per hour
**Total Stock Removal:** .010"

Shown above is the latest Thompson vertical spindle machine grinding the diesel engine cylinder blocks of a leading truck manufacturer. To meet the demand for fast, continuous production, both the fixture and grinding cycles are automatic and are interlocked to prevent accident. A separate hydraulic power source operates the single place fixture which locates the cylinder block on the main bearing holes.

Since any variations in stock removal would affect the compression ratio of the engines, constant accuracy is controlled throughout the grinding cycle. The operator merely sets wheel contact with the work and automatic operation begins.

Thompson vertical spindle surface grinders are made in various types and sizes to meet all job requirements. All machines of 40 inches and up in work length are equipped with the Hydra-Cool Hydraulic System*—the exclusive Thompson feature that eliminates all heat distortion throughout the machine.

*Pat. Applied For

**MACHINE CYCLE (Total Stock Removal .010")**

**CYCLE I**

1. Load work piece into fixture and start table cycle.
* 2. Manually lower grinding wheel to contact work piece.
3. Automatic downfeed of wheel occurs at each table reverse to remove .010" stock.
4. Spark out to final size with table moving to start position.
* 5. Manually elevate grinding wheel to starting position and release work piece in fixture.
6. Table automatically stops.

**Can be furnished as automatic functions.*

Thompson SURFACE GRINDERS

**THE THOMPSON GRINDER CO.**
**SPRINGFIELD, OHIO**

*"Keep Thompson in mind for that daily grind"*



For more information fill in page number on Inquiry Card, on page 197.

# Tool Steel Topics

BETHLEHEM STEEL

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributors: Bethlehem Steel Export Corporation


# Lustre-Die held costs down in molding plastic covers

"We need," said the customer, "a plastic cover to protect our sealed motors. It's to be drip-proof and sturdy, yet must be a low cost item. Do you have a grade of die steel which will help us produce such a cover economically?"

The mold maker, Dollins Tool & Gage Co., Independence, Mo., put the problem up to Ford Steel Co., St. Louis, our local tool steel distributor. Quick as a flash came their recommendation: "Lustre-Die!"

The electric-furnace steel performed to everyone's satisfaction. It was economical. It took a high polish. It had high compressive strength. It machined easily. It performed well in molding the parts which were held to a close tolerance of .001 in.

Lustre-Die is just the ticket for molding plastics because its properties make possible a bright, mirror-like polish. Lustre-Die has the proper basic analysis for molding plastics. And it offers something more — alloy fortification! Lustre-Die is heat-treated by oil-quenching and tempering to augment its properties, and is furnished ready for machining and polishing.

Lustre-Die is carefully inspected to insure cleanliness. It is free from injurious porosity or surface pitting. And there's no problem about inclusion-causing additions.

Lustre-Die is a good steel to keep in mind for your next plastic-molding operation. Your Bethlehem tool steel distributor can furnish it from stock. Why not give him a call?

## BETHLEHEM TOOL STEEL ENGINEER SAYS:

### *Here's Why Air-Hardening Steels are Good Performers*

When a large group of various types of tools made from air-hardening tool steels is compared with a group of similar tools made from steels which require liquid quenching for hardening, it will be found that the air-hardened tools outperform the liquid-quenched tools in service. This result will not necessarily be found in the comparison of individual tools, but will appear if a large enough variety and number of tools are studied.

The reason why air-hardened tools outperform liquid-quenched tools can be summed up in one word — consistency. The consistent performance of air-hardened tools is evident in many ways:

#### DIMENSIONAL STABILITY

All tools, when subjected to the hardening operation, develop small but measurable dimensional changes (so-called distortion). Air-hardened tools not only show less dimensional change than liquid-quenched tools, but the changes that do occur are remarkably similar in each tool when identical tools are made up. By contrast, liquid-hardened tools show considerably more variation from tool to tool when identical tools are produced.

#### HARDNESS

Duplicate air-hardened tools invariably show the same hardness after heat-treatment. Liquid-quenched tools may show erratic hardness in various locations on a tool, due to variations in effectiveness of the liquid quench; however, duplicate tools will each have a somewhat different hardness pattern.

#### RESIDUAL QUENCHING STRESSES

All tools develop residual internal stresses due to the hardening operation. Liquid-quenched tools develop high internal residual stresses because of the variations in cooling rate which occur in different locations on a tool during the quench. If improperly controlled, these stresses can lead to cracking of the tools in heat-treatment or in grinding, or the load-carrying ability of the tools may be low and erratic.

By contrast, air-hardened tools develop only a low degree of internal stress during hardening, because of the comparatively uniform cooling in the quench. Furthermore, the degree of internal stress which develops is uniform from tool to tool, so that the service performance of duplicate tools is reasonably consistent.

The advantages of air-hardening steels cannot be realized, however, unless they are hardened by air-quenching. It is possible to harden all air-hardening steels by liquid-quenching (oil-quench or salt-quench as in martempering) and this is frequently done because of the convenience of existing heat-treatment equipment. However, liquid-quenching of air-hardening steels is a serious mistake, because it sacrifices almost all the basic advantages of air-hardening steels. Liquid-quenching not only increases distortion and internal stresses, but may lead to cracking of some of the tools during heat-treatment. Air-hardened steels which are properly quenched in air do not crack in heat-treatment.

Bethlehem offers a full range of air-hardening steels: Bearcat for shock applications, A-H5 for general-purpose tool and die work, and Lehigh H for maximum production runs.

# PRODUCING

LE MAIRE

## STANDARD

### MILLING HEAD UNITS

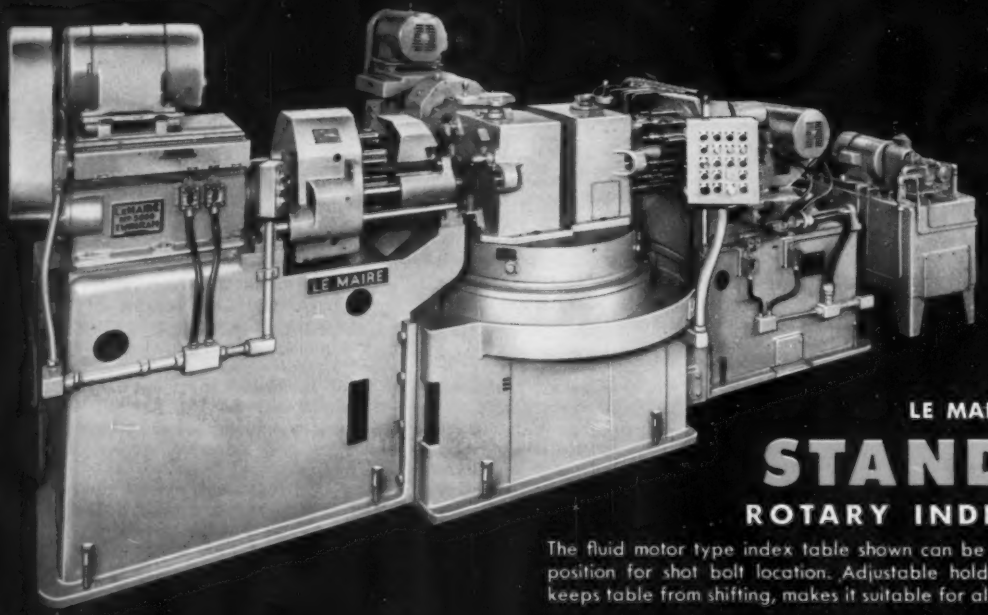
Vertical milling head cleans up mounting face of oil pump covers. Other operations on this machine include drilling and reaming. Production is 90 parts per hour at 100% efficiency.

LE MAIRE

## STANDARD

### DRILLING UNITS

Multiple tooling on standard units performs drilling, reaming, counterboring and tapping of 75 flywheels hourly. While units shown are quill type, LeMaire also manufactures standard way type units.




LE MAIRE

## STANDARD

### ROTARY INDEX TABLES

The fluid motor type index table shown can be set to stop in exact position for shot bolt location. Adjustable hold-down arrangement keeps table from shifting, makes it suitable for all types of machining.

# with LE MAIRE

## STANDARD BUILDING BLOCKS

*Give You Economy . . . Flexibility . . . Simplicity*

Before you automate : . . *investigate* the complete LeMaire line of standard hydraulic power units. Each is practical, efficient, economical . . . and nearly as flexible in application as a standard electric motor!

These LeMaire "building blocks" are designed for interchangeable installation on a wide variety of standard bases. This allows low-cost unitized construction, in minimum lead time, of a "special" which solves *today's* production machining problem . . . and which can be economically converted or modified to meet *future* needs.

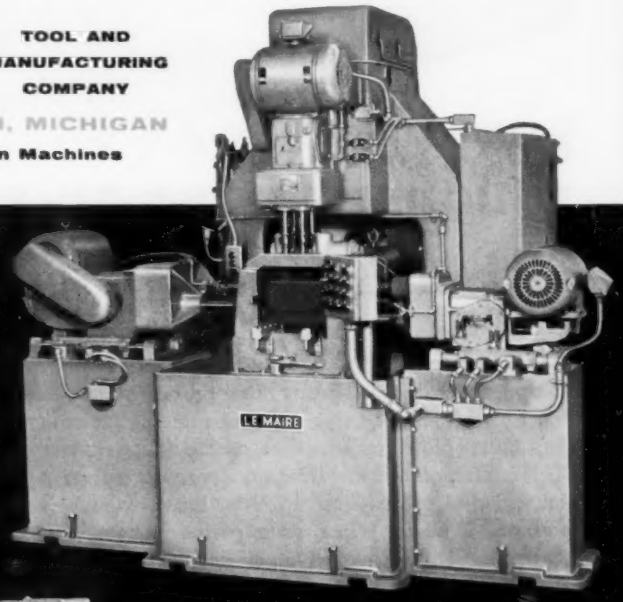
LeMaire standard units are suitable for drilling, boring, counterboring, reaming, spot-facing, tapping and milling. They operate in horizontal, vertical or angular positions. Infinite control of feeds is provided, along with construction which assures twist-free, straight line, uniform operation under all production conditions. All units are built to J.I.C. standards.

For practical, economical, flexible automation, check the possibility of using LeMaire "do-it-yourself" building blocks . . . or ask LeMaire engineers to recommend the right combination for your specific production machining problem. Send parts or prints for prompt recommendations.

**LE MAIRE** TOOL AND MANUFACTURING COMPANY

2657 S. TELEGRAPH ROAD • DEARBORN, MICHIGAN

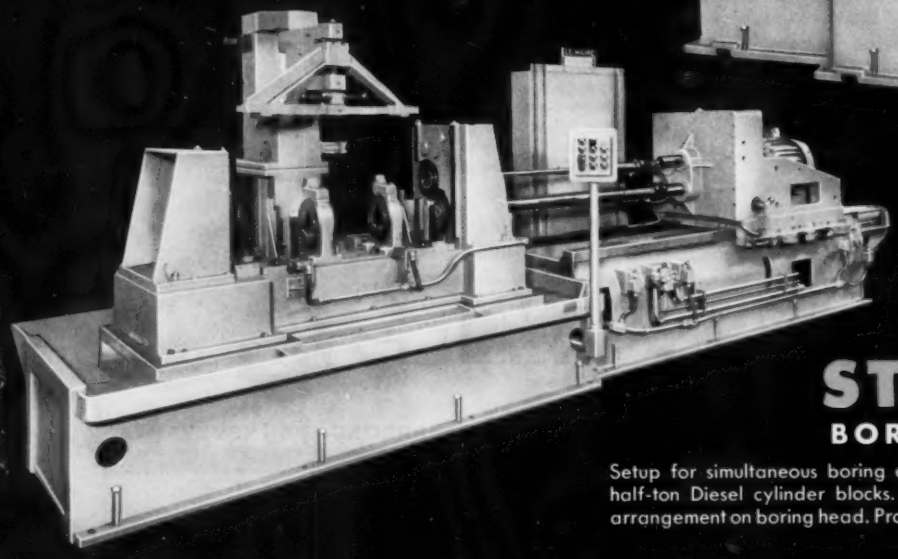
**Designers and Builders of Special High-Production Machines**




LE MAIRE

### STANDARD LEAD SCREW TAPPING UNITS

Four sides of farm tractor hydraulic reservoir are tapped at once by this machine, arranged with various size master lead screw tapping units. Production is 56 parts per hour at 100% efficiency.



LE MAIRE

### STANDARD BORING HEAD UNITS

Setup for simultaneous boring of camshaft and crankshaft bores in half-ton Diesel cylinder blocks. Way type unit has tool positioning arrangement on boring head. Production is 9.4 cylinder blocks per hour.

# FORMING TODAY'S TOUGHER, "HARD-TO-HANDLE" METALS TAKES THE *IMPACT* OF THE CECOSTAMP

THE CECOSTAMP provides a controlled *impact* blow not obtainable on any other press. The operator has, at his fingertips, full command of the ram for sharp blows or squeezes as the job requires. This control of the blow intensity assures the correct impact and pressure required by the metal being formed. It easily forms, to a permanent set, the "hard-to-handle" metals such as heat treatable aluminum alloys, austenitic stainless steels, magnesium and titanium. There are standard Cecostamps to fit nearly every requirement with working areas from 21" x 18" to 120" x 120". Stroke of ram can be increased for deeper draws if necessary.

*Send for Bulletin 30-L-5.*

**SOME OF THE ADVANTAGES OF CECOSTAMPS**

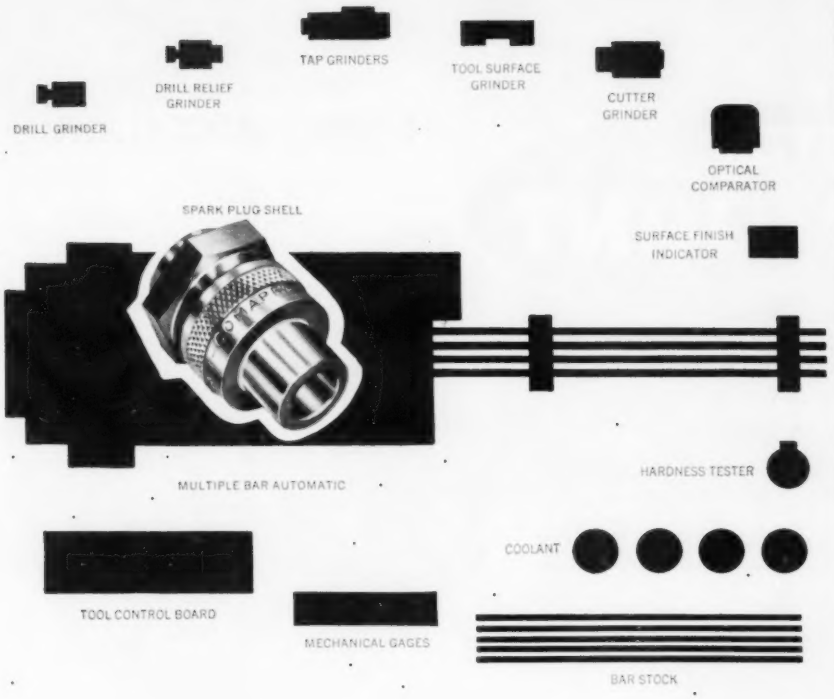
1. *Sets sharp changes of contour to permanent shape*
2. *Produces components within strict dimensional limits*
3. *Shearing can be combined with stamping of simple shapes*
4. *Skillful operators can develop and form many shapes difficult to form on any other type of press*
5. *Controlled blow is well suited to forming large integral parts*
6. *Low tooling cost and rapidity of die fabrication*

# CECOSTAMP

CHAMBERSBURG ENGINEERING CO.

*Builders of* THE IMPACTER
"FORGING IN MID-AIR"

CHAMBERSBURG, PENNSYLVANIA




# Are your cost conditions optimum?

(If not, you will want to read this announcement)

Only optimum conditions can bring about the lowest possible machining costs. In agreement with this, 17 manufacturers (see list at right) have agreed to coordinate their interests in the establishment of a Cooperative Machining Project to determine optimum conditions for the use of multiple bar Conomatics.

Six basic factors (see column at right) and many sub-factors comprise the "conditions" of any machining performance. The qualities, responsibilities, and coordination of these can vary from plant to plant. And, as they vary, so will machining costs.

As representative of quality products and services to the machine user, this group will select work components* across industry that are representative of great volume, popular grades of steel, and commonly used tool combinations.

Each job will be thoroughly analyzed and developed to arrive at the best conditions for the lowest cost results. Simulated production runs will then be made to determine the actual cost per piece. With exception of those retained for samples, all work pieces will be returned to the steel mill along with the chips.

This non-profit project is housed in an enclosed area in one section of the Cone plant. Without obligation, work results will be available to any "automatic" user, interested in machining costs. Please address all inquiries to the Comapro Dept.

*spark plug shell illustrated now under development

**CONE AUTOMATIC MACHINE COMPANY, INC., WINDSOR, VERMONT, U.S.A.**

**BAR STOCK**

*sponsored by:*
*Jones & Laughlin Steel Corp.*
*Joseph T. Ryerson & Sons, Inc.*

Grade Identity • Machineability
Machineability Uniformity
Hardness Uniformity
Adherence to Chemical and Physical Specs
Straightness • Cleanliness
Smoothness of Finish
Squareness of Chamfered Ends
Uniformity of Diameter
Uniformity of Lengths

**TOOLS, TOOL HOLDERS & TOOL MAINTENANCE EQUIP.**

*sponsored by:*
*Abrasive Machine Tool Co.*
*John Bath & Co., Inc.*
*Edward Blake Company, Inc.*
*Black Diamond Saw and Machine Works, Inc.*
*The Cleveland Twist Drill Co.*
*Firth Sterling, Inc.*
*Jones & Lamson Machine Co. (Thread Tool Division)*
*Royal Oak Tool and Machine Co.*
*Scully-Jones and Co.*

Perishable Tool Material
Adherence to Hardness Specs
Adherence to Accepted Design
Suitability to Work Requirements
Tool Holder Interchangeability
Holder Adaptability to Perishable Tool Replacement and Job Changeover

**MEASUREMENT CONTROL**

*sponsored by:*
*Brush Electronics Co.*
*Federal Products Corporation*
*Jones & Lamson Machine Co. (Comparator Division)*
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*Wilson Mechanical Instrument Div., American Chain & Cable Co., Inc.*

Dimensions, Weight, Hardness, and Smoothness of Bar Stock
Dimensions, Hardness, and Smoothness of Tools and Work
Setting Control of Tools
Machine Accuracies

**COOLANT & LUBRICATION**

*sponsored by:*
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Type Identity • Cooling Qualities
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**MULTIPLE BAR AUTOMATIC**

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Chip Disposal

**PERSONNEL** *by:*

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Responsible Periodic Checking of All Factor Functions of Supplier and User
Teamwork to Establish Optimum Machining Standards
Responsible Inspection of Qualities and Measurable Properties of All Factors
Optimum Condition Machining Manuals for Various Personnel Levels

For more information fill in page number on Inquiry Card, on page 197

OPTIONAL MOUNTING
OPTIMUM PERFORMANCE

# BOSTON Gear® OPTIMOUNT

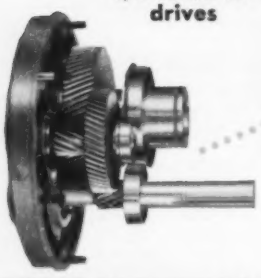
TRADEMARK

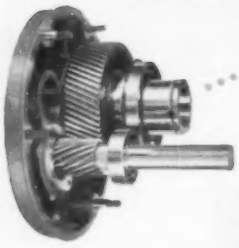
HELICAL GEARED
**REDUCTORS • RATIOMOTORS**
AND FLANGED REDUCTORS
**SHAFT MOUNTED and BASE MOUNTED**

**A New achievement in STANDARDIZATION**
by industry's most experienced specialists in speed reducer design

## From Stock

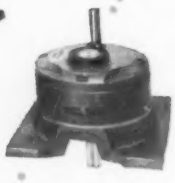
**SINGLE or DOUBLE REDUCTION**
**1/6 to 15 HP drives**





**HORIZONTAL BASE MOUNTED**

**VERTICAL BASE MOUNTED**



**SHAFT MOUNTED**

**DELIVER MAXIMUM POWER** with highest efficiency. Precision helical gearing made by BOSTON Gear specialists, — in units tested and proved to meet the highest quality standards.

**ALL OPTIMOUNT Ratiomotors** are available also without motors as FLANGED REDUCTORS. You buy and attach your own choice of motor

**OPTIMOUNT** offers you unlimited adaptability to modern drive demands, in helical geared speed reducers made to BOSTON Gear quality standards.

Call your Distributor for complete information. Let him demonstrate the design features that assure top-rated efficiency and lasting economy. Boston Gear Works, 65 Hayward St., Quincy 71, Mass.

**66 MODELS FROM STOCK**

**680 OPTIONAL MOUNTING ARRANGEMENTS**

For nearest Distributor LOOK UNDER "GEARS" in the 'Yellow Pages'

**CALL YOUR BOSTON Gear DISTRIBUTOR**

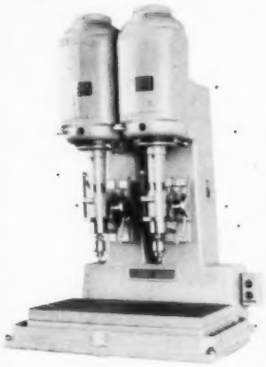
— STANDARDIZATION PAYS —®

**NEW Catalog OP-1** lists complete data on OPTIMOUNT, — selection charts, engineering data. Get your copy from your local Distributor.

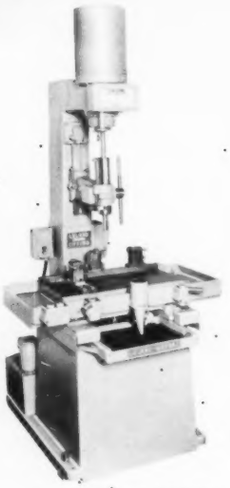
For more information fill in page number on Inquiry Card, on page 197

# LELAND-GIFFORD

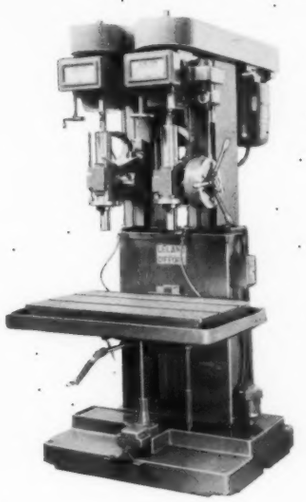
## standard



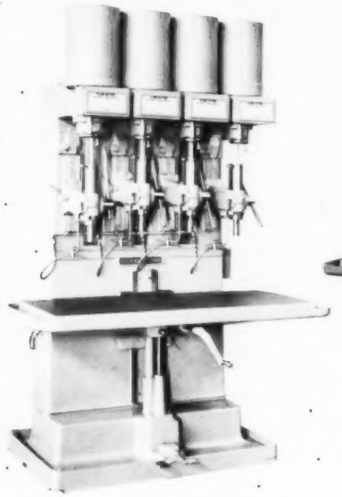
**FOR BENCH INSTALLATION**
No. 1LMS is available with one to four individual motor spindles; 12″ or 20″ swing; speeds up to 9000 RPM. Also available in floor type — one to six spindles.



**NEW HOLE LOCATOR**
for fast, accurate, jigless drilling with optical positioning from a simple, re-usable layout chart. Available in capacities of standard L-G No. 2 and No. 3 drilling machines.

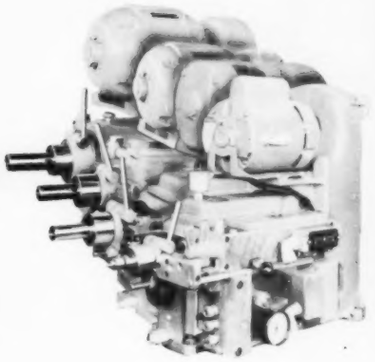


**FOR HEAVY DUTY DRILLING**
No. 3MVB is available with eight speeds up to 1800 RPM; 24″ swing; one to four spindles; hand, power or hydraulic feed.



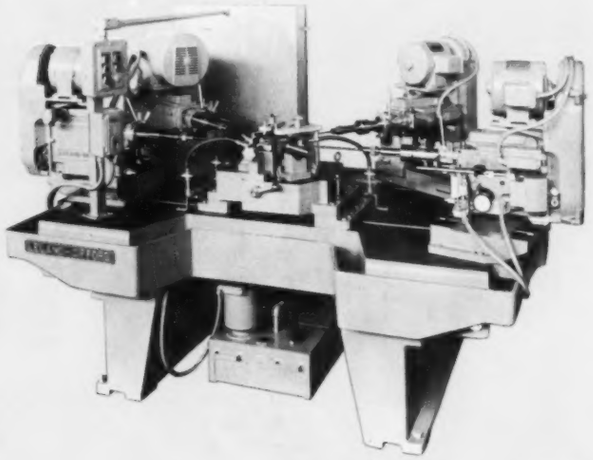
**INDUSTRY'S STANDARD**
for precision drilling and tapping. No. 2LMS is available in one to six spindles; 20″ or 26″ swing; speeds up to 3600 RPM; hand, power or hydraulic feed.

**TOOLROOM DRILL PRESS**
No. 2LMS has 26″ swing, oversize table, eight speeds, reversing motor for tapping. No. 3MVB with extra capacity also available.

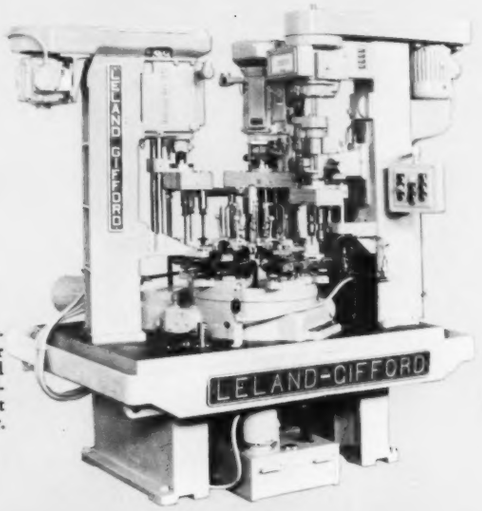


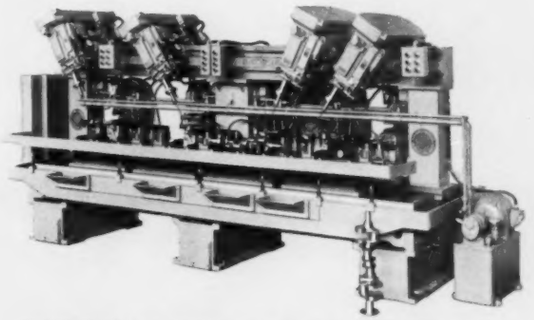
**SELF-CONTAINED UNITS**
Four sizes for holes from .020″ to 1.500″. Furnished with motor, hydraulic pump and accumulator system; dual feed, step by step or plain feed.

## specials



**FLEXIBLE SETUP FOR DEEP HOLE DRILLING**
Four-unit special machine drills deep, intersecting, lubrication holes in compressor crankshafts. Electric controls prevent drill interference. Interchangeable fixtures and adjustable heads accommodate four different workpieces. Production: 30 pieces per hour.



**CRANKSHAFT OIL HOLES AT 20 SHAFTS PER HOUR**
Eight deep oil holes per shaft are drilled by this four-station machine with self-contained units rail mounted for maximum flexibility. Shafts are manually loaded with automatic clamping and release.

**MULTIP OPERATIONS AT 160 PIECES PER HOUR**
Three-uni multiple head machine with 6-station index tab drills, chamfers and taps a ¼-28 hole and drills reams, tap drills, spot faces and taps a ⅜-16 hol in steel forgings. Parts are double loaded and powe clamped.

# DRILLING MACHINES

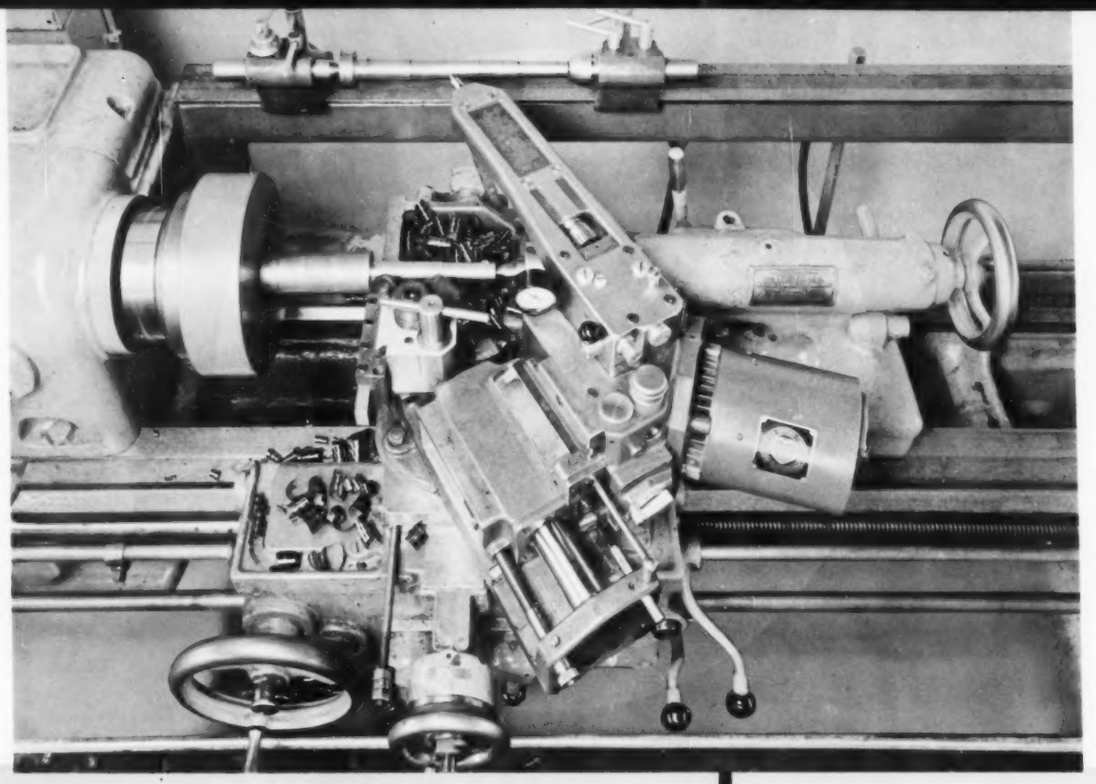
# LELAND-GIFFORD

## *Machine Tools*

- Standard Sensitive and Hydraulic Feed Drilling Machines
- Special Drilling Machines
- New Hole Locator with Optical Positioning
- Self-Contained Drilling Units
- Toolroom Drill Presses

**See Next Page for** NEW SINGLE UNIT, HYDRAULIC LATHE TRACER ATTACHMENTS

## SINGLE UNIT HYDRAULIC LATHE TRACER ATTACHMENTS



A simple — easy-to-operate unit — high in precision — low in cost.
Traces from round or flat templates, sample parts or wood models.
Compact — self contained — no cumbersome hose lines.
Tool slide operates at any angle for turning, facing or boring.
Rear mounting of template assures accessibility.
Built-in micrometer control for sizing.
Obtains finish in one cut — not two.
Roller traveling rest eliminates deflection, insures roundness.
For lathes up to 30 H.P. — over 4000 lbs. tool thrust available.
Actual records show production increase of 500% possible on numerous parts.

*Designed and built by the country's largest maker of self-contained hydraulic feed drilling units.*

*Built in three sizes to fit all standard or heavy duty lathes from 12" to 25" (up to 27½" swing). Installed or removed in minutes. Does not limit utility of lathe.*

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# T-J spacemaker cylinder

# Quality Engineered

## to give quality results

### with Extras . . . at No Extra Cost!

You get more—much more—when you specify and use any of T-J's complete line of Spacemaker cylinders. The Spacemaker is engineered to give you better, more accurate, and longer service—offers, exclusively, many extras . . . that are STANDARD, AT NO EXTRA COST!

Designed to eliminate tie-rods, providing greater strength . . . saves space . . . reduces manhours and costs in all push-pull-lift operations. IMMEDIATE SHIPMENT in a wide range of styles and capacities, with 64,000 combinations. Write for Bulletin SM 155-3 with complete engineering details. The Tomkins-Johnson Co., Jackson, Mich.

T-J TOMKINS-JOHNSON
RIVETORS AIR AND HYDRAULIC CYLINDERS CUTTERS CLINCHORS

**METAL PISTON ROD SCRAPER** . . . Standard at No Extra Cost!

**NEW "SUPER" CUSHION FOR AIR** . . . Standard at No Extra Cost!

**CHROME PLATED CYLINDER BORES AND PISTON RODS** . . . Standard at No Extra Cost!

**ONE PIECE PISTON** . . . Standard at No Extra Cost!

**NEW "SELF-ALIGNING" MASTER CUSHION FOR HYDRAULIC USE** . . . Standard at No Extra Cost!

**NO TIE-RODS TO STRETCH** . . . Standard at No Extra Cost!

**STREAMLINED DESIGN** . . . Oil Pressure to 750 P.S.I.—air to 200 P.S.I. Standard at No Extra Cost!

**FORGED SOLID STEEL HEADS** . . . Standard at No Extra Cost!

For more information fill in page number on Inquiry Card, on page 197

# Now . . . a heavy-duty SOLUBLE OIL without bad odor, formulated and priced for general application!

Find Your STUART Rep. In The Yellow Pages

**SERVICE LIFE GUARANTEE**

We GUARANTEE your complete satisfaction with the bacteria resistance of Dasco D-20, or any of the Stuart soluble oils listed at the bottom of this page, on a 100 per cent money back basis.

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Stuart

**METALWORKING LUBRICANTS**

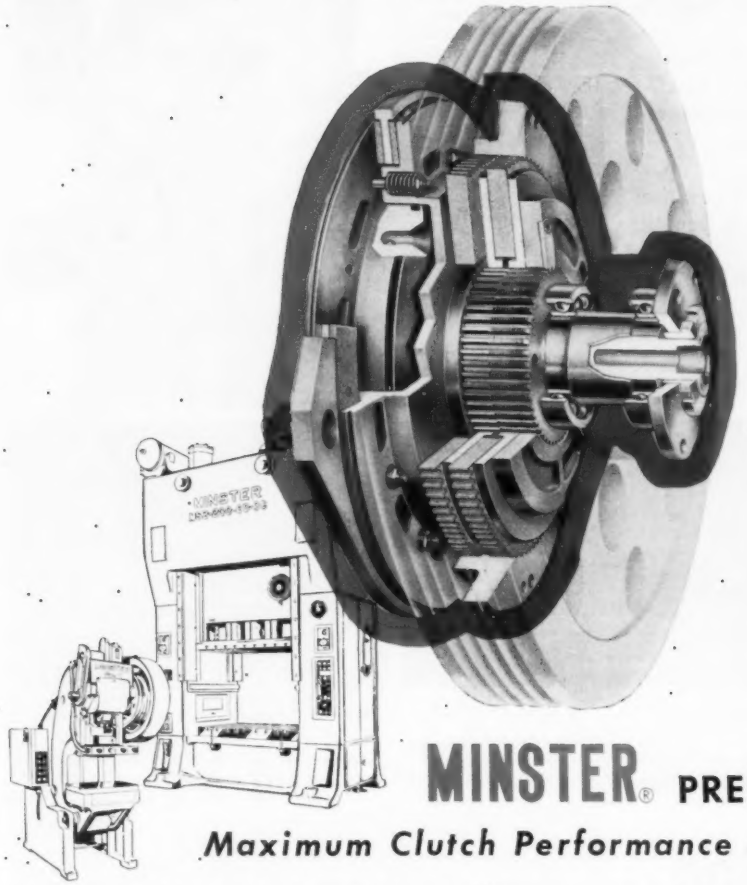
Ever analyze the real cost of letting cutting oils turn rancid? Action of a sufficient quantity of bacteria to turn a coolant tank sour actually destroys the stability of the emulsion, shortens service life, and requires extra man-hours to aerate your machines. Stuart's new heavy-duty soluble oil, Dasco D-20, not only inhibits bacteria growth, but gives you better-than-average performance on a variety of machining operations. It can be used at different dilutions for both cutting and grinding. At no extra cost, you get a top-quality EP base and "ABI" additive that is GUARANTEED to keep the emulsion stable and sweet *three* to *four* times longer than other mixtures. Phone your Stuart service center or write the factory for complete information or a test sample of Dasco D-20.

WRITE FOR NEW FREE BOOKLET

Gives you typical results made possible by Dasco D-20 on broaching, turning, reaming, drilling, grinding, tapping, and threading operations. Describes how one automotive plant saved $7200 per month by using Dasco D-20 in 365 different machines.

**SOLVOL "X" • DASCO D-20**
**CODOL "X" • DASCO SUPER-SOLUBLE "X" BASE**

# There's a BIG DIFFERENCE in AIR FRICTION CLUTCHES



**THE MINSTER CLUTCH IS MORE EFFICIENT**

## MINSTER® PRESS USERS *Always Get Maximum Clutch Performance and Longest Clutch Life*

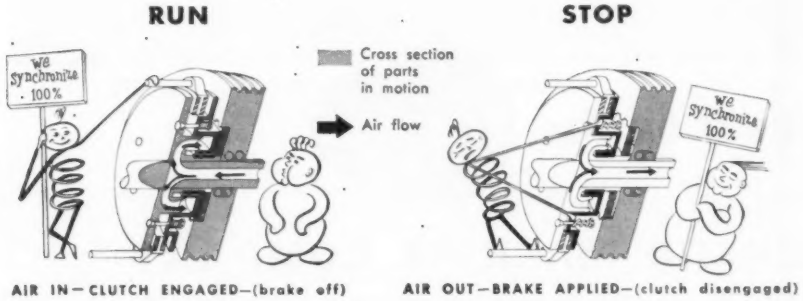
It's not unusual for the clutch and brake on a Minster press **to perform, shift after shift, on rapid single cycle operation for eight, ten or twelve years without ever being disassembled for relining.**

Users of all types and sizes of Minster presses consistently get that kind of service from the Minster patented Combination Air Friction Clutch and Brake.

Improvements in the design of the Minster clutch are being made continuously by Minster, **the press builder that developed and pioneered the air friction clutch for presses.** Performance records prove that, with a Minster clutch, the length of service and operational value is there.

Next time you're evaluating press equipment or considering a press clutch conversion, bear in mind, all air friction clutches are *not* alike.

## THE MINSTER MACHINE COMPANY, MINSTER, OHIO




AIR IN—CLUTCH ENGAGED—(brake off)

AIR OUT—BRAKE APPLIED—(clutch disengaged)

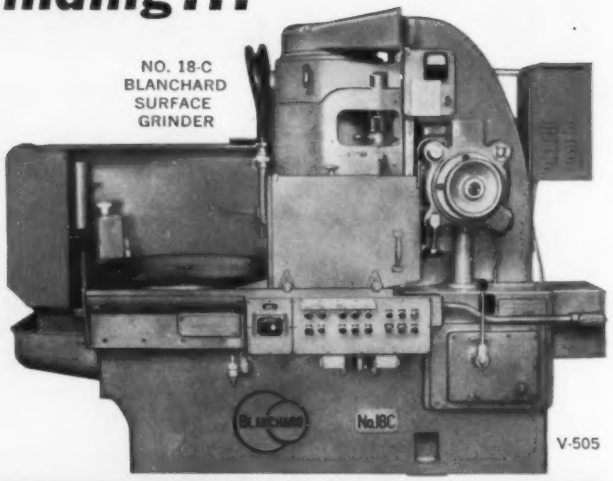
***Compare the number of parts . . .***

*The Minster Combination Air Friction Clutch and Brake is one synchronized unit with one moving member engaging the clutch by air pressure in one direction and applying the brake in the opposite direction as air exhausts. Movement from full brake to complete engagement is the absolute minimum, assuring fast action at any speed for quick, controlled stopping.*

For more information fill in page number on Inquiry Card, on page 197

# For better, easier grinding...

Whether you're "hogging" off stock from rough castings or precision grinding to a tolerance of ±.0005", you can do it better and easier with the Blanchard No. 18-C Surface Grinder. Once the work is set up, the automatic cycle handles every operation from start to finish. The operator is free to prepare the next load of work or to operate a second No. 18-C Grinder.



**Cast Iron Plate.** Blanchard ground at the rate of 30 pieces – 60 surfaces – per hour. Stock removal ⅛" each side.

**Steel Bars.** Blanchard ground at the rate of 48 pieces – 192 surfaces – per hour. Stock .040"-.045" from each side. Limits ±.001" square, flat and parallel.

**Hot Rolled Steel Cams.** One operator and one No. 18-C Blanchard produce 225 pieces – 450 surfaces – per hour. Stock removal 1/32" each side. Limits ±.001".

# just push a button...

- Automatic size control to ±.0005"
- Duplication of repetitive loads
- Pre-set "spark out" time for flatness and surface finish
- No more "operator worry" on close work – greatly reduced fatigue
- A large part of operator's time available for
  - (a) Handling or slushing work pieces
  - (b) Filing burrs
  - (c) Selecting correct wheel and preparing for next job
- Specially-designed sizing device with built-in feature to compensate – automatically – for wheel wear during grinding cycle.

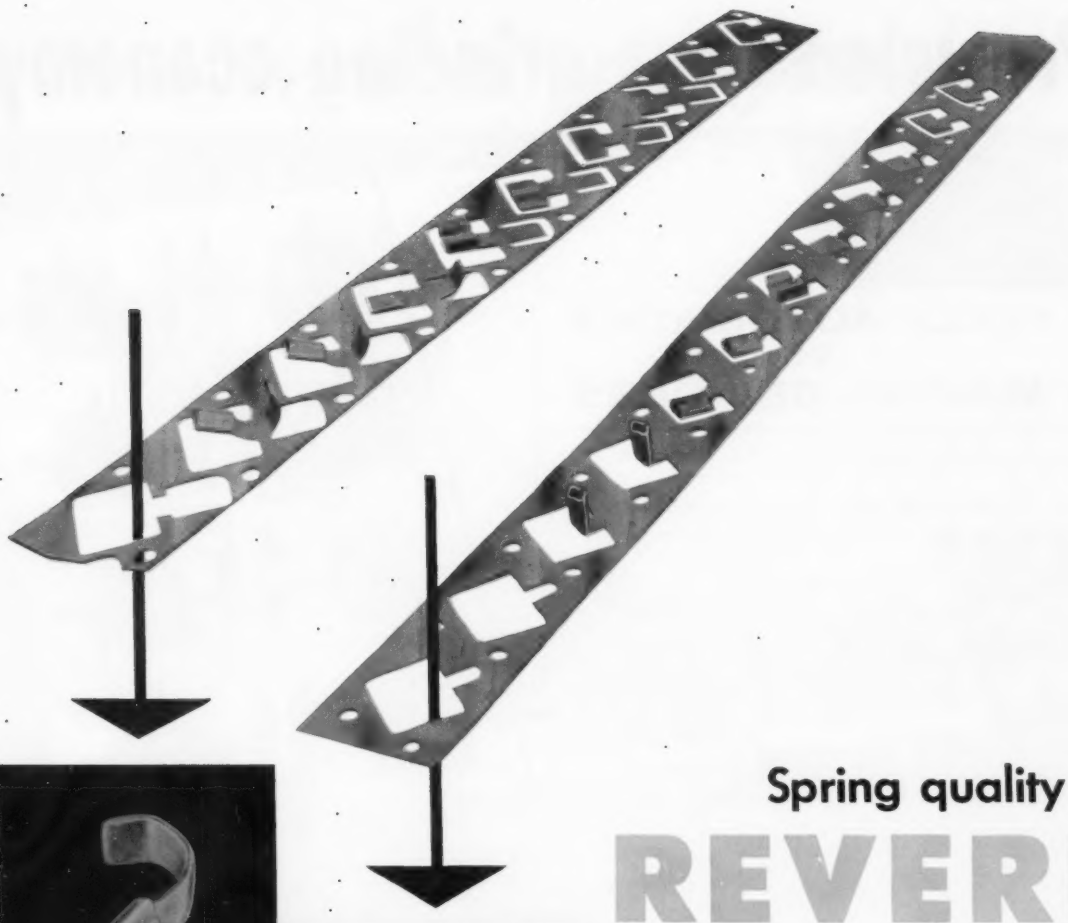
All of these features give you *more efficiency at reduced costs!*

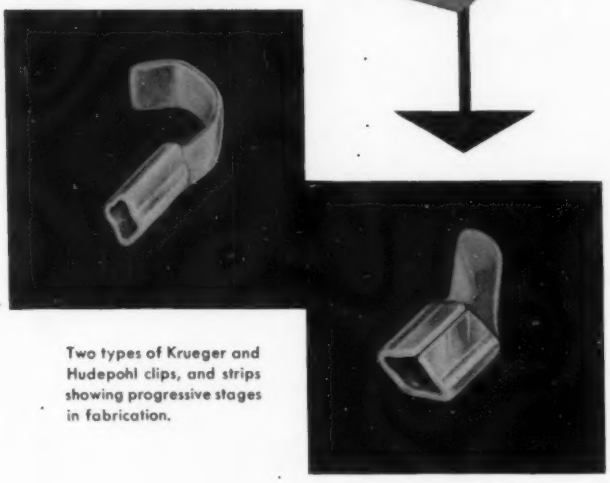
**PUT IT ON THE BLANCHARD**

*Send for your free copy of Model 18-C folder.*

## THE BLANCHARD MACHINE COMPANY

64 STATE ST., CAMBRIDGE 39, MASS., U. S. A.





Two types of Krueger and Hudepohl clips, and strips showing progressive stages in fabrication.

# Spring quality of REVERE PHOSPHOR BRONZE makes solderless connections possible

It is not always the case that solder has to be used to make good electrical connections. Often phosphor bronze clips can be used, tightness being achieved through the hard-gripping spring quality of this metal. Take the clips made by Krueger and Hudepohl, Inc., Cincinnati 2, Ohio. This company uses Grade A 5% Revere Phosphor Bronze to make its connections for refrigerators, and for submersible pumps and hydraulic control units. Such services require not only tight permanent connections, but the ability to withstand severe temperature variations, as well as vibration. Revere Phosphor Bronze meets the needs perfectly. In developing this application, the Revere Technical Advisory Service collaborated closely with the customer on the important matter of temper required both for fabrication and end use. Krueger and Hudepohl report no rejects. The metal is supplied in the form of strip, one inch wide, and in very long coils, so that down time for coil set-up on each progressive die machine is minimized. Send for your free copy of "Revere Phosphor Bronze," which provides details about qualities, performance, and applications.

**REVERE**

**COPPER AND BRASS INCORPORATED**

*Founded by Paul Revere in 1801*

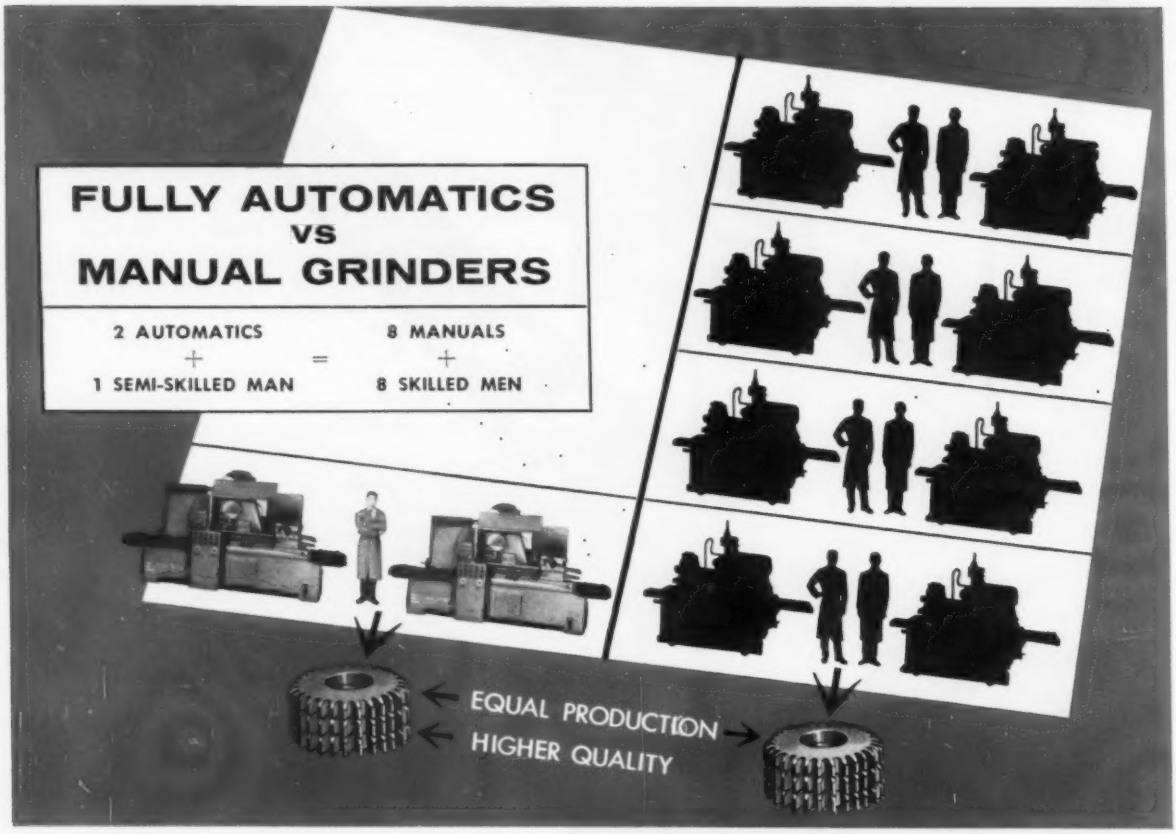
230 Park Avenue, New York 17, N. Y.

*Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.*

"The Revere Four-Way Service" is a 16mm sound motion picture in color, interesting and informative. If you would like to see it, write nearest Revere Sales Office.

For more information fill in page number on Inquiry Card, on page 197

# Precision gear grinding economy




# —Plus this 4-way versatility

Choose from any of these cycles with selective feed increments:

1 Rough grinding
2 Rough grind; finish grind
3 Rough grind; semi-finish grind; finish grind
4 Manual grind

50th ANNIVERSARY—1908-1958

GEARGRIND Detroit

UP TO 36" P.D.

**GEAR DATA**

| | |
|---|---|
| No. Teeth | 96 |
| Pitch Diameter | 25.7" |
| Diametral Pitch | 3.6 |
| Pressure Angle | 25° |
| Face Width | 4.5" |

**FLOOR TO FLOOR PRODUCTION TIME**

| | |
|---|---|
| Single Gear/Arbor | 55 min/gear |
| Two Gears/Arbor | 33 min/gear |

**GEAR ACCURACY**

| | |
|---|---|
| Involute Profile | Within .0002" |
| Tooth to Tooth Spacing | .0003" max. |
| Runout of Pitch Diameter | .0006" total |
| Lead Error | Less than .0001"/" |

For all the facts—write today!

**THE GEAR GRINDING MACHINE COMPANY**

3921 Christopher, Detroit 11, Michigan

*Manufacturers of:*

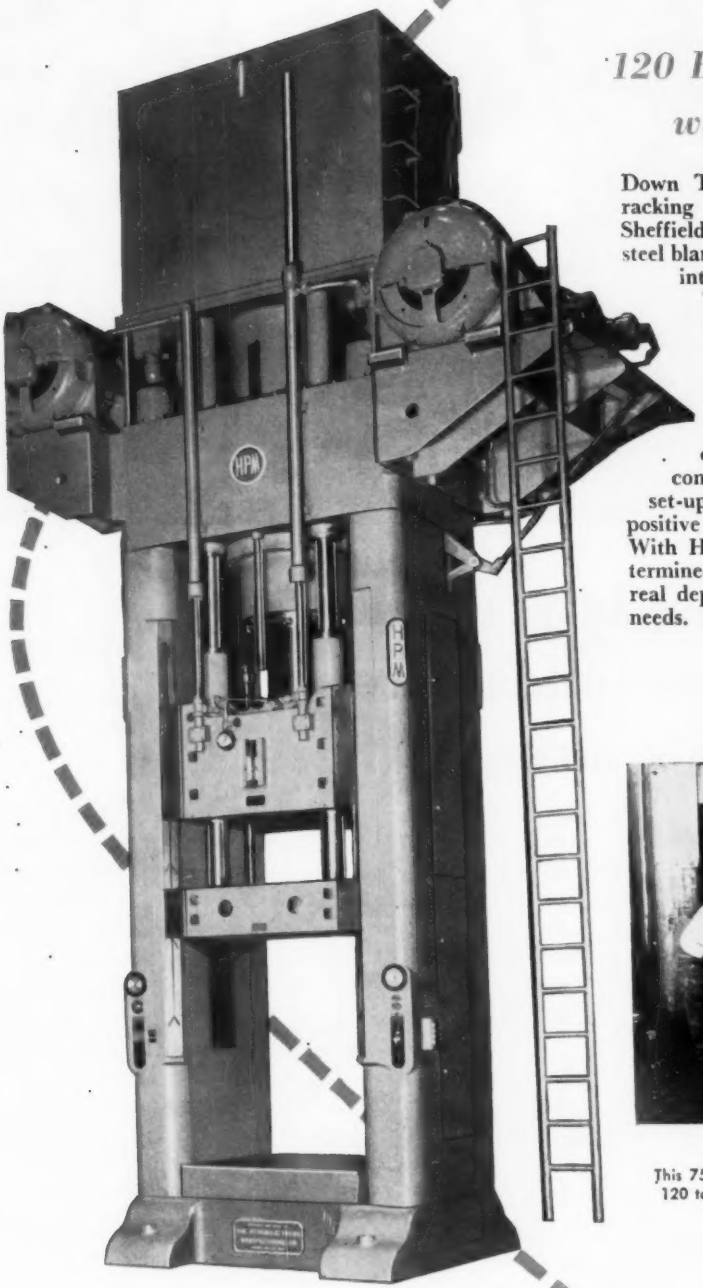
The Detroit Screwmatic 750, Automatic Screw Machine.
RZEPPA ("Sheppa") Constant Velocity Universal Joints

58-MT5A



For more information fill in page number on Inquiry Card, on page 197

# BIG THINGS WITH H-P-M PRESSES



## *120 Big Draws Every Hour with 750-Ton H-P-M*

Down Texas way, this big 750-ton H-P-M is racking up impressive production figures for Sheffield Steel Corporation of Houston. The .210" steel blanks, 39" in diameter, are fed automatically into the press and drawn to a depth of 10". The finished tank heads are 30" in diameter; later welded to tank cylinders for gas storage use.

Here's why H-P-Ms really pay off for Sheffield . . . smooth fast drawing action without impact . . . fastraverse closed-circuit system for constant and controllable drawing speed . . . quicker die set-up . . . positive overload protection . . . positive blankholder pressure for entire draw. With H-P-Ms you have press reversal at predetermined pressure or position. Specify H-P-M for real dependability—for all of your metalworking needs. Write today for complete information.

This 750-Ton H-P-M with automatic feeding device turns out 120 tank heads an hour for the Sheffield Steel Corporation.

For one dependable source . . . for one responsibility . . . for all your metalworking needs . . . specify H-P-M.

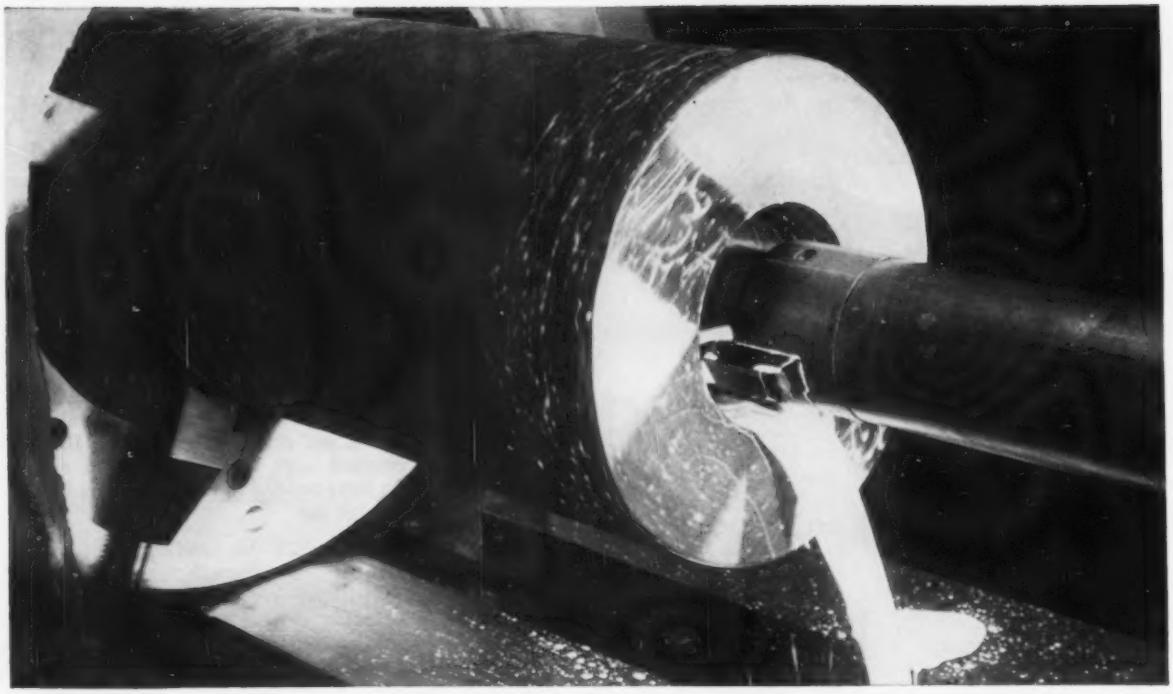
H835

**THE HYDRAULIC PRESS MFG. COMPANY**

**A DIVISION OF KOEHRING COMPANY • MOUNT GILEAD, OHIO, U. S. A.**

HPM

For more information fill in page number on Inquiry Card, on page 197



# Finish boring is your first step with Timken® seamless steel tubing —the hole's already there!

YOU save time and money when you make hollow parts with Timken® seamless steel tubing instead of bar stock. You eliminate drilling because the hole's already there. Finish boring is your first production step. With less metal to machine away you get more parts per ton of steel.

And because Timken seamless steel tubing eliminates one boring operation, your screw machine stations are free for other jobs. You get more machining capacity without adding machines.

And you get a better quality finished product with Timken seamless steel tubing because of the way we make it. A solid round is forged over a mandrel, thoroughly working the metal inside and out. This rotary piercing operation gives Timken seamless steel tubing its fine forged quality, uniform spiral grain flow. With exacting control of temperature and piercing speed, we maintain this quality from tube to tube, heat to heat, order to order.

And to further increase your steel savings, Timken Company engineers will be glad to recommend the most economical tube size for your hollow parts job. You'll get a size guaranteed to clean up to your dimensions. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO".

**TIMKEN** *Fine Alloy* **STEEL**

TRADE-MARK REG. U. S. PAT. OFF.

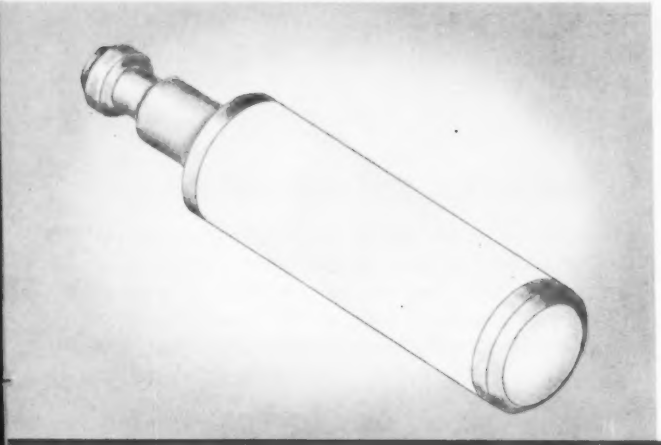
**SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING**



For more information fill in page number on Inquiry Card, on page 197

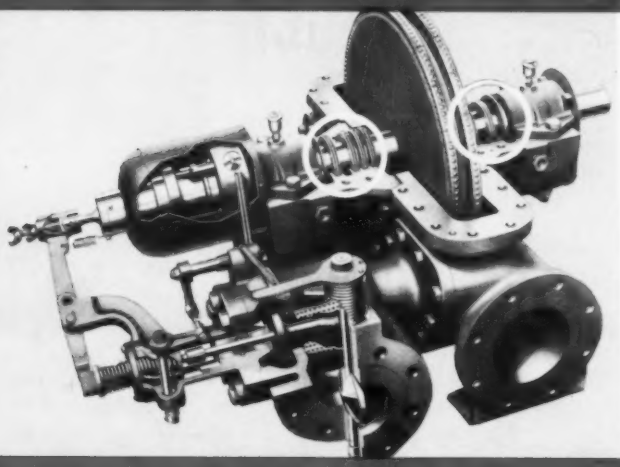
# Metco Metallizing News

Developments in sprayed metal and ceramic coatings



## Ceramic coatings for long-life—low cost

Many types of pump parts, including plungers, rods, seals and impeller shafts are being coated with ceramics which provide superior abrasion resistance, are inert to most corrosive materials, provide excellent thermal barriers. An important production advantage is the elimination of fusing necessary with self-fluxing alloys. These coatings are applied easily and at low cost with Metco's ThermoSpray Powder Gun.



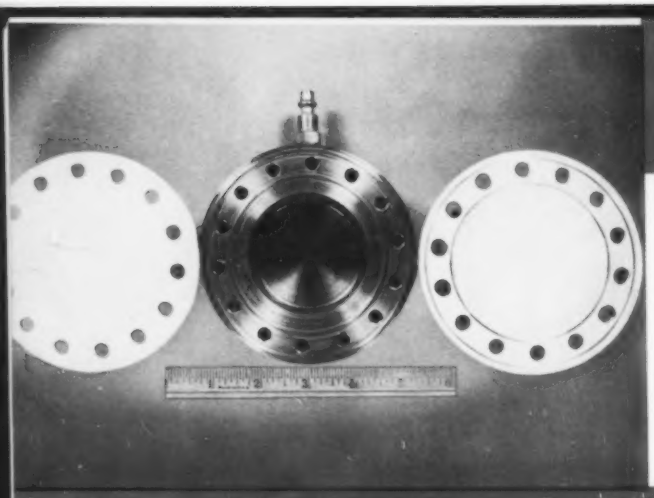
## Prevents rust cutting

Westinghouse offers users of their turbines an important plus value by spraying the gland zones of the shafting with a high chrome-nickel steel, which prevents rust-cutting of the carbon gland segments. Many other turbine and pump manufacturers are improving the wear quality of their products by this simple method.

## Electrical contact protection

General Electric protects the ignitors of their Ignitrons with metallized molybdenum, which is sprayed on areas where the carbon tip meets the metallic supporting structure. This procedure insures long service life of the ignitron by preventing damage to the carbon ignitor tip at contact area, which is required to carry considerable current. A real benefit for General Electric customers.

MORE



# Metallizing News

## Sprayed aluminum seals

Sprayed aluminum gasket provides advantages of unspliced seal and ductility for low-temperature applications. Developed initially for guided-missile fuel tanks, the method is applicable in any equipment handling low temperature fluids — pumps, automatic valves, reservoirs, surge cylinders, couplings. Photo shows sprayed gaskets, before (left) and after (right), bolting to flanged coverplate. Note impression of coverplate bead on sprayed gasket after removal.

## Atmospheric corrosion protection

Transformer cases used in street lighting systems are rust-proofed by metallizing with pure zinc at the Kuhlman Electric Company, Bay City, Michigan. Surfaces are prepared for metallizing simply by blasting with angular steel grit. Protection afforded by zinc metallizing is superior to that achievable by any other method since any coating thickness may be applied and protection is positive even if the coating is badly scratched, since it is anodic to the steel case. Result: long life . . . exceedingly low maintenance cost.

## Automatic control systems for metallizing

Automatic control systems are available for production line metallizing. Provision is made for automatic gun idling, which may be operated by limit switches on a conveyer line; master transfer control permits control of any number of guns from a central station. System is extremely flexible, to permit modification for each user's specific requirements. All controls can be located on the panel or may be mounted directly at the gun in cases where such a location would improve operating efficiency.

**Sprayed coatings of metals and ceramics** provide the design engineer with wide new ranges of mechanical and physical characteristics with which to work. These may be applied to particular areas of a product with consequent increase in flexibility of design. If you would like additional information, write for Bulletin 136—"Basic Engineering Data on Wire and Powder Sprayed Coatings of Metals and Ceramics," Bulletin 127—"ThermoSpray Ceramic Coatings," Bulletin 126—"High Speed Low Cost Hard Facing."

METCO

METCO, ThermoSpray
Reg. U.S. Pat. Off.

**METALLIZING ENGINEERING CO., INC.**

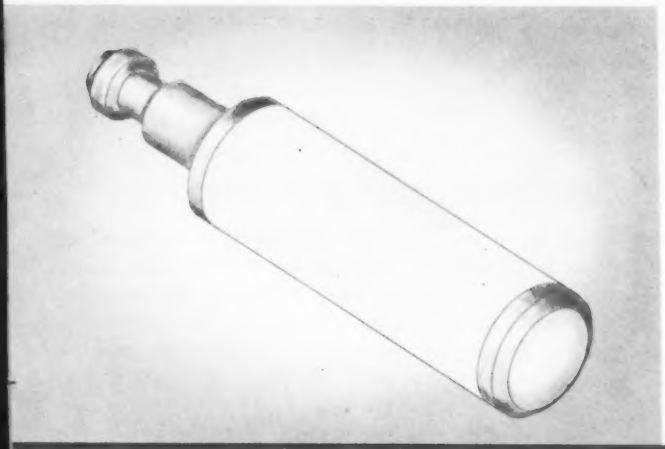
1131 Prospect Ave., Westbury, Long Island, New York

In Great Britain: METALLIZING EQUIPMENT CO., LTD. Chobham near Woking, England

MORE

# Metco Metallizing News

Developments in sprayed metal and ceramic coatings



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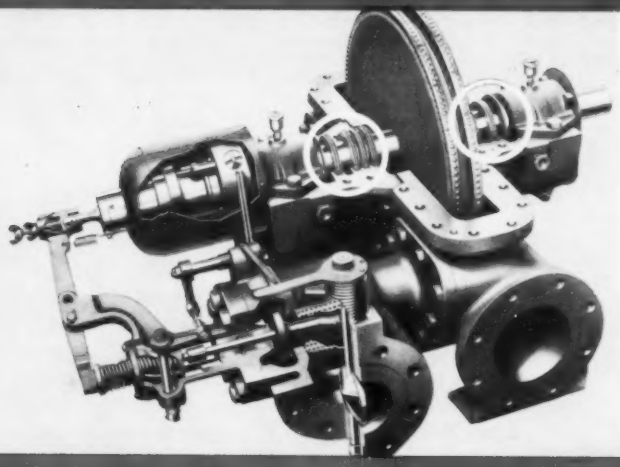

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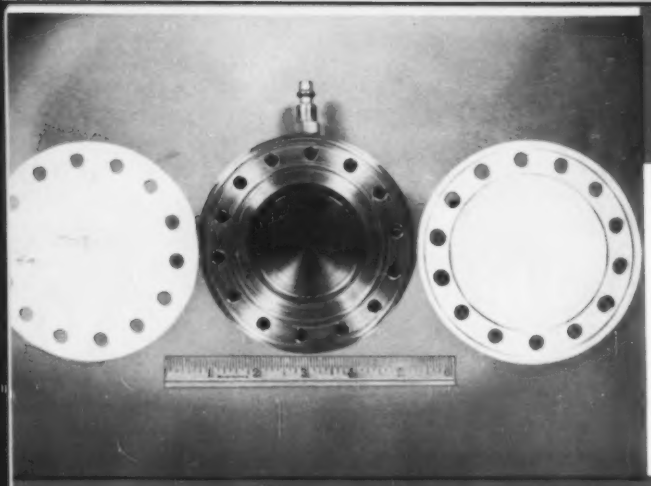

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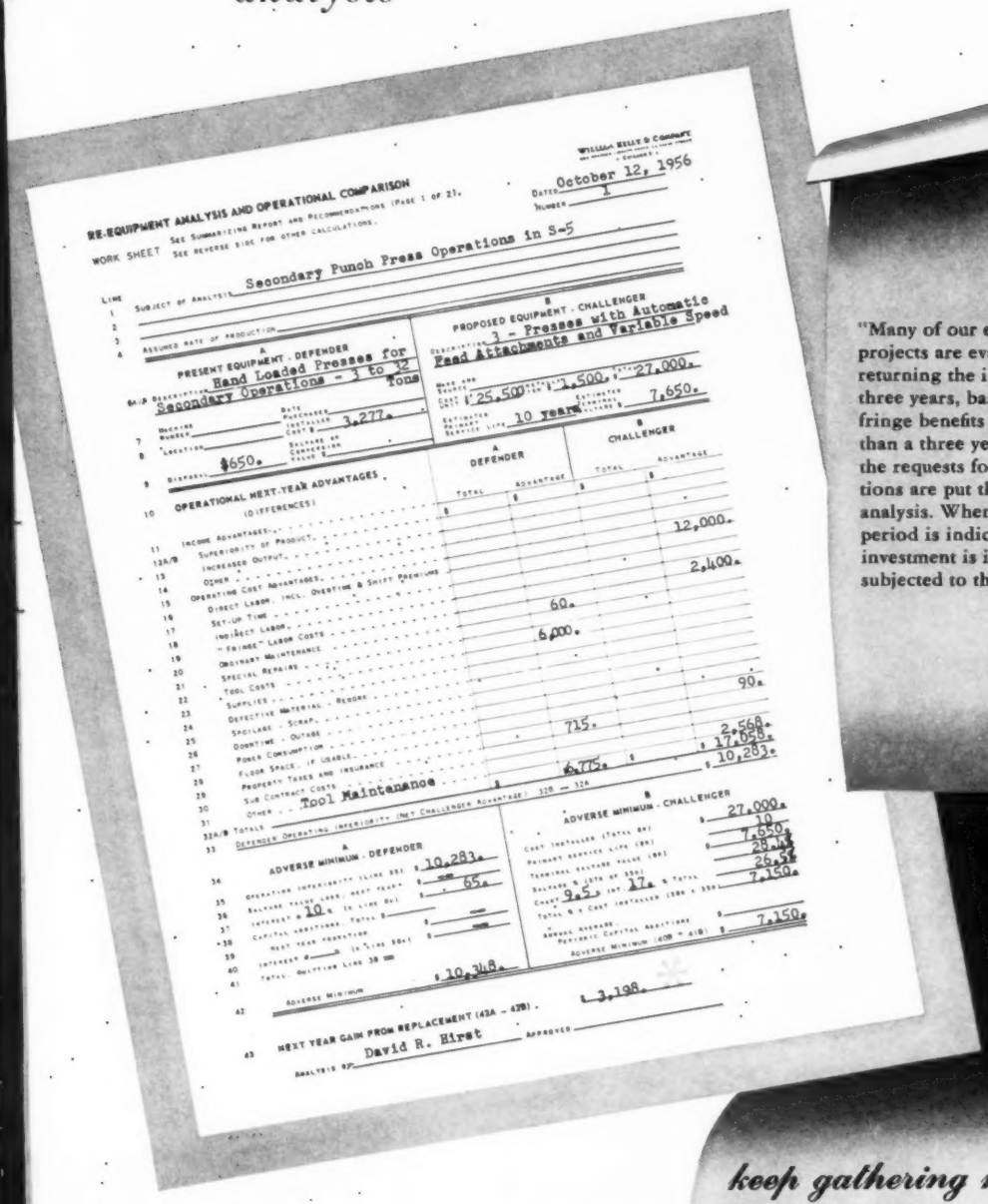
MORE

# *how* CUTLER-HAMMER *reduces their cost savings opportunities to careful analysis*



RE-EQUIPMENT ANALYSIS AND OPERATIONAL COMPARISON — WILLIAM KELLEY & COMPANY — Dated October 12, 1956 — Number 1

WORK SHEET — See Summarizing Report and Recommendations (Page 1 of 2). See reverse side for other calculations.

Subject of Analysis: Secondary Punch Press Operations in S-5

Assumed Rate of Production

| A — PRESENT EQUIPMENT - DEFENDER | | B — PROPOSED EQUIPMENT - CHALLENGER | |
|---|---|---|---|
| Description | Hand Loaded Presses for Secondary Operations - 3 to 12 Tons | Description | 3 - Presses with Automatic Feed Attachments and Variable Speed |
| Machine Number | | Make and Source | |
| Location | | Cost $ | 25,500. |
| Date Purchased / Installed | 3,277. | Installation $ | 2,500. |
| Cost $ | | Estimated Salvage Value $ | 27,000. |
| Salvage or Conversion Value $ | | Estimated Remaining Service Life | 10 years |
| Disposal | $650. | Estimated Salvage Value $ | 7,650. |

OPERATIONAL NEXT-YEAR ADVANTAGES (DIFFERENCES)

| | A DEFENDER Total $ | A DEFENDER Advantage $ | B CHALLENGER Total $ | B CHALLENGER Advantage $ |
|---|---|---|---|---|
| Income Advantages: | | | | |
| 12A/B Superiority of Product | | | | |
| Increased Output | | | | 12,000. |
| Other | | | | |
| Operating Cost Advantages: | | | | |
| Direct Labor, Incl. Overtime & Shift Premiums | | | | 2,400. |
| Set-Up Time | | | | |
| Indirect Labor | | | | |
| "Fringe" Labor Costs | | 60. | | |
| Ordinary Maintenance | | 6,000. | | |
| Special Repairs | | | | |
| Tool Costs | | | | 90. |
| Supplies | | | | |
| Defective Material - Rejects | | | | |
| Spoilage - Scrap | | 715. | | 2,568. |
| Downtime - Outage | | | | 17,058. |
| Power Consumption | | | | |
| Floor Space, if Usable | | | | |
| Property Taxes and Insurance | | | | |
| Sub Contract Costs | | | | |
| Other - Tool Maintenance | | 6,775. | | 10,283. |
| 32A/B Totals | | | | |
| Defender Operating Inferiority (Net Challenger Advantage) 32B — 32A | | | | |

| A — ADVERSE MINIMUM - DEFENDER | | B — ADVERSE MINIMUM - CHALLENGER | |
|---|---|---|---|
| Operating Inferiority (Line 33) | 10,283. | Cost Installed (Total 8A) | 27,000. |
| Salvage Value Less Next Year's | — | Primary Service Life (8A) | 10 |
| Interest @ 10 % (% Line 8A) | 65. | Terminal Salvage Value (8A) | 7,650. |
| Capital Additions, Total | — | Salvage @ 28% of 35A | 28,314 |
| Next Year Operation | — | Salvage @ 17% % Total Cost 9.5 Inv. | 26,32 |
| Interest @ — % (% Line 38A) | — | Total % Cost Installed (38B × 35A) | 7,150. |
| Total Deferring Line 38 | — | Annual Average Periodic Capital Additions | — |
| Adverse Minimum | 10,348. | Adverse Minimum (40B + 41B) | 7,150. |

NEXT YEAR GAIN FROM REPLACEMENT (42A − 42B) — 3,198.

Analysis by: David R. Hirst — Approved

"Many of our equipment investment projects are evaluated on the basis of returning the investment in less than three years, based on the labor and fringe benefits alone. When much less than a three year return is assured, the requests for investment appropriations are put through without further analysis. When close to a three year period is indicated, or when a substantial investment is involved, the project is subjected to the detail MAPI analysis."

***Philip Ryan***
President
CUTLER-HAMMER, Inc.

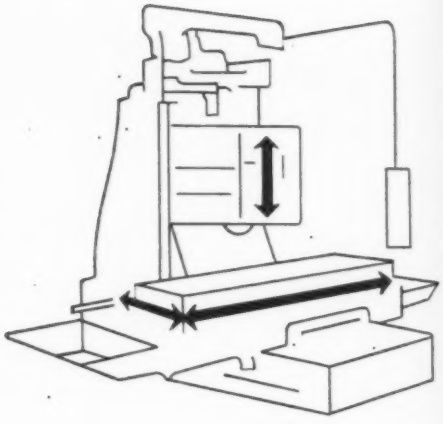
**GAIN** from replacement by the Cutler-Hammer formula is . . . after required interest or return on the new investment. . . . after full allowance (by the formula) for future obsolescence of the new equipment.

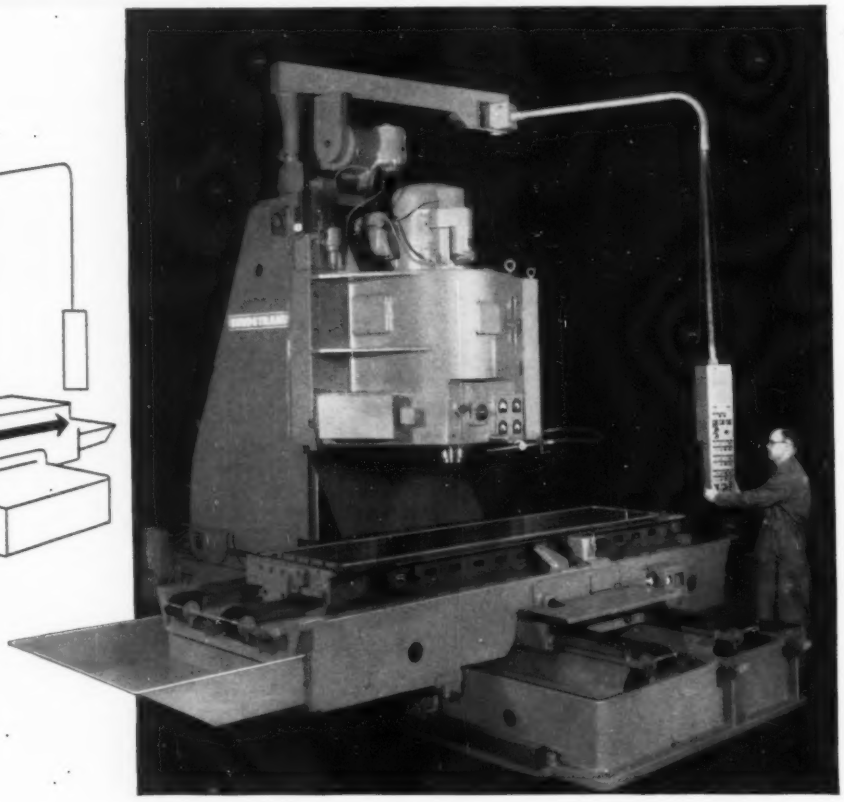
***keep gathering metal-working production ideas . . . be well informed when the time for replacement arrives.***

July, 1958

ROCKFORD INSERT GROUP

# New Sundstrand 50 hp Vertical Rigidmil Provides Three Directional Feed





Transverse, longitudinal, and vertical feed makes the new Sundstrand 50 hp vertical Rigidmil an efficient producer on large work.

● Sundstrand's new vertical Rigidmil combines the ruggedness needed to handle large workpieces with workhandling flexibility by providing powered transverse, longitudinal, and vertical feed — controlled conveniently from a single pendant station. The 50 hp milling head has a speed range of 15 to 1500 rpm with speeds selected from the control pendant. Head transmits 1 hp per rpm up to maximum rated hp.

Outstanding accuracy is assured by the fixed column and fixed base design. The fixed column holds head rigidly for 50 hp cuts, while the fixed base eliminates overhang deflection and insures maximum support for the cutter for all positions of saddle and table.

Maximum height between spindle nose and top of table is 30 inches. Up to 44 inches transverse stroke of saddle and 96 inches table feed stroke enable large workpieces to be machined with maximum efficiency.

Vertical feed rate of head is infinitely variable from 3/16 to 50 inches per minute with rapid travel being 50 ipm in either direction. Transverse feed of saddle is infinitely variable between 3/8 and 75 ipm; rapid travel is 75 ipm in either direction. Longitudinal feed is infinitely variable between 3/8 and 150 ipm with rapid travel in either direction being 150 ipm. All movements are pushbutton controlled at pendant.

*Write Sundstrand for more details on the 50 hp vertical Rigidmil.*

## SUNDSTRAND MACHINE TOOL CO.

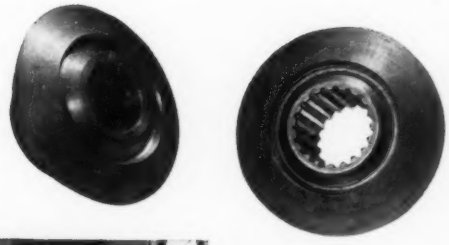
2530 ELEVENTH ST., ROCKFORD, ILLINOIS

SUNDSTRAND "Engineered Production" Service*

AUTOMATIC LATHES | SIMPLEX RIGIDMILS | DUPLEX RIGIDMILS | TRIPLEX RIGIDMILS | SPECIAL MACHINES

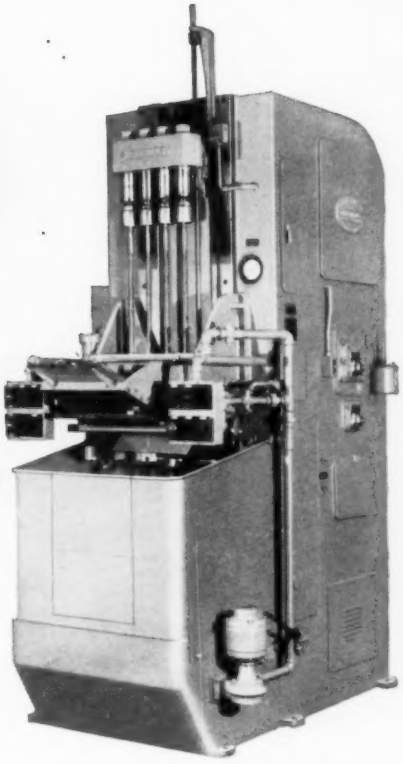
CENTER OF MACHINE-TOOL EXCELLENCE ROCKFORD, ILLINOIS, U.S.A.

# American's Design Features Provide the Basis for Automatic Broaching



Splines are broached in these bevel side gears four at a time in a fully automatic cycle.

Chute feed loading on Sundstrand-American vertical pull-up machine (right) minimizes need for operator skills. Close-up at left shows four parts in broaching position and four others ready for the next cycle.



● A standard machine is all it takes to broach parts in large volume — provided the basic machine is designed to accommodate automatic features readily. For instance, a gravity chute and loading slide combine with this standard American pull-up machine for a broaching production of 1000 parts per hour. All the operator has to do is keep the four stations in the chute filled with parts — the other operations are fully automatic. All portions of the work cycle are electrically interlocked to prevent damage to the machine or tooling.

Should the part requirements change, the basic machine can be retooled for internal broaching of completely different parts with minimum outlays in time and cost. Almost without exception, Sundstrand-American's long production experience will pay off here too by keeping changes to the minimum required for peak production of the new part.

Sundstrand-American "Engineered Production" provides all three elements required by an efficient broaching installation: (1) proper broach tool design, (2) the best machine for the job, and (3) efficient fixturing. You get the manufacturing skill and engineering experience required to perform these three essential functions at no extra cost. Let Sundstrand-American show you the big difference in broaching installations.

*Write today for your copy of Bulletin A-628 describing Sundstrand-American vertical pull-up machines.*

**SUNDSTRAND-American BROACH DIV.**

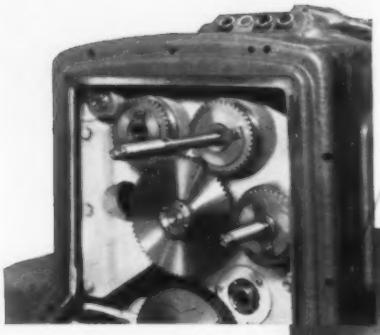
SUNDSTRAND MACHINE TOOL CO., ROCKFORD, ILLINOIS

| BROACHING TOOLS | THREE WAY | SINGLE RAM | HORIZONTAL | DUPLEX RAM | PRESSES |
|---|---|---|---|---|---|
| | | | | | |

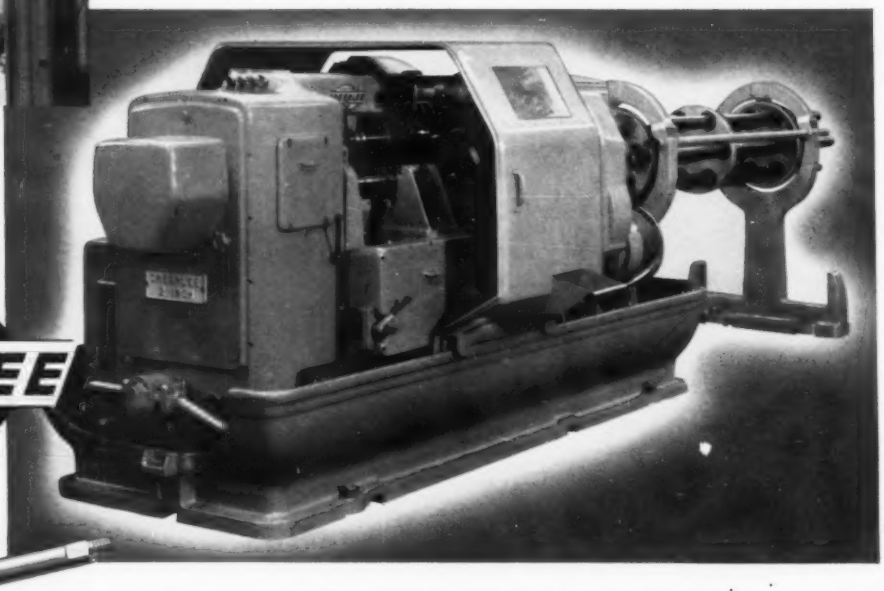
SUNDSTRAND "Engineered Production" Service"



CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**



# GREENLEE LEAD-SCREW FEED ASSURES *Precision* THREADING and TAPPING



PRODUCTION MACHINERY

**GREENLEE**

## PRODUCES UNIFORM HIGH QUALITY... Reduces Scrap ... Lowers Costs!

The Greenlee precision lead-screw threading arrangement makes it easy to machine parts otherwise impractical on an automatic bar machine. Precision Acme, tapered and multi-lead threads are machined in the high speed and feed ranges required. Smooth, clean thread form, fine fit and high tolerance concentricity make lead-screw threading profitable. Built-In Duplex clutches on 6-spindle machines reduce set-up time on simultaneous tapping and multi-tooled jobs. The profitable lead-screw arrangement can be applied to Greenlee machines in the field as well as on new Greenlee Automatics. It will pay you to investigate.

*Want more information? Write today for Catalog A-405.*

**GREENLEE BROS. & CO.**

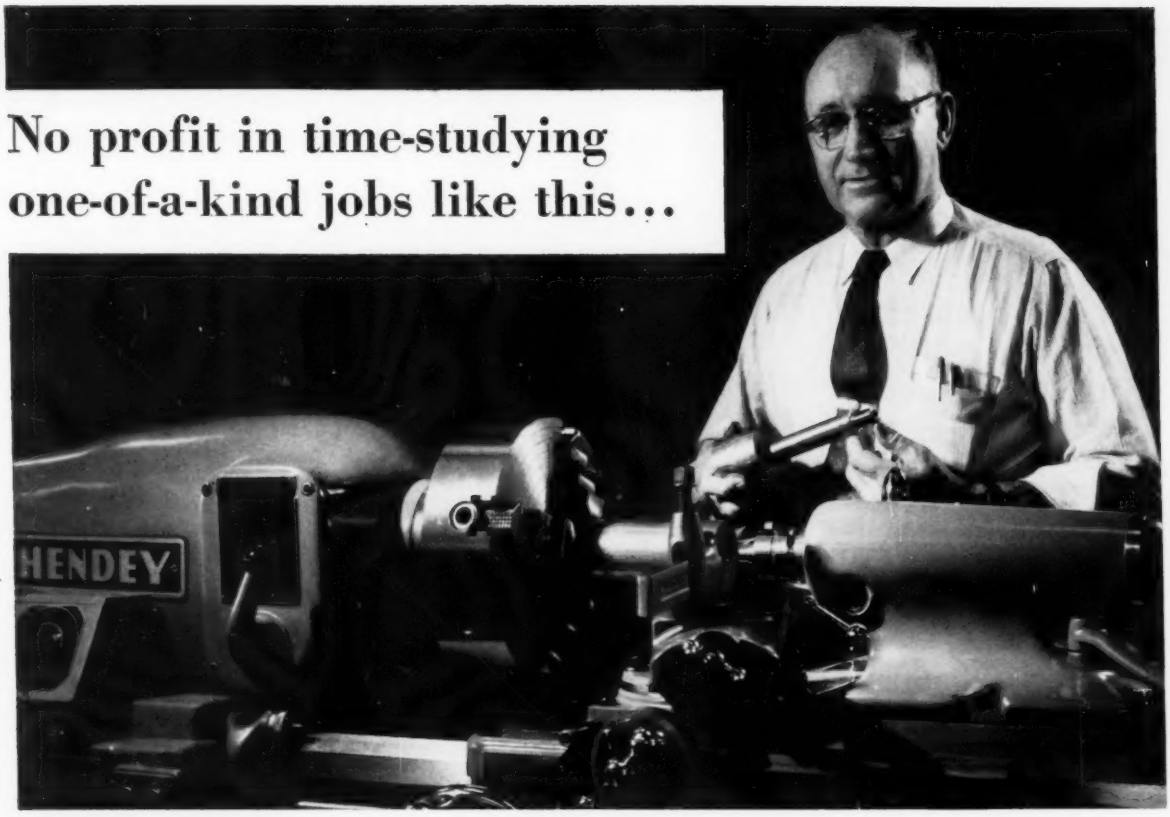
**1867 Mason Ave.**

**Rockford, Illinois**



CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

# No profit in time-studying one-of-a-kind jobs like this...



Center Drill @ 400 rpm

**10 sec.**

Rough turn 6-in. section from 3-in. to 2-in. dia. 5 passes @ 500 rpm 3 passes @ 650 rpm

**4 min., 13 sec.**

Finish turn 1-in. section from 2-in. to 1-in. dia. 2 passes @ 850 rpm

**12 sec.**

Change tool and adjust speed, and feed for threading

**2 min.**

Cut 10 thrds per in. on ¾-in. dia. @ 100 rpm 12 passes @ .005 in. 4 passes @ .001 in.

**4 min., 32 sec.**

## But a Barber-Colman lathe will give you built-in time control for efficient short-run turning!

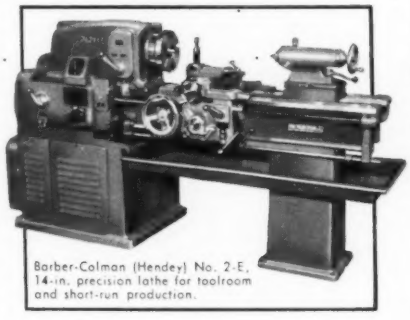
**EXAMPLE: Three-inch dia. 4615 steel shaft is turned and threaded in 11 min., 7 sec.; operation includes three tool changes and four different machining steps.**

How do you know when you're getting a day's work for a day's pay on short-run turning jobs?

One good way is by putting these jobs on a modern Barber-Colman* No. 2-E Lathe, with control features that take the work out of setup and operation. The pictures at the left show you how the lathe effectively reduces time and cost on a typical one-piece job.

### Changes speeds on the fly

An important timesaving feature of the "2-E" is the variable speed drive. You don't have to stop the cut in order to change speeds — just turn to the speed you want, shown on the direct-reading dial, or constantly change speeds while the machine is under load. It's easy to work at the correct speeds always, when facing, turning stepped diameters, or cutting tapers.



Barber-Colman (Hendey) No. 2-E, 14-in. precision lathe for toolroom and short-run production.

### Exclusive power drive advantages

Only the No. 2-E gives you precision, fine finish turning at speeds from 30 to 1500 rpm through a belt-driven spindle . . . *plus* smooth, geared power *at the spindle* for no-slip driving in the low-speed range. You can change from belt to geared drive simply by shifting a lever on the headstock. The spindle can be stopped in *two seconds*, even at the highest speed, through the instant-acting electric brake.

### Simplifies thread cutting

You can start, stop, and reverse the carriage when cutting threads, regardless of direction of feed, simply by positioning the lever on the apron. This saves time when chasing metric threads or odd threads that cannot be picked up on the thread-chasing dial, gives you maximum efficiency for short-run work. Write for Catalog 7175.

***"Don't expect a day's work for a day's pay on yesterday's machine tools!"***

**Barber-Colman Company**
72 Loomis Street Rockford, Illinois

*Formerly Hendey

BARBER COLMAN

## PRECISION LATHES



FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

NEW **HYDRAULIC** SLOTTER OFFERS BOTH

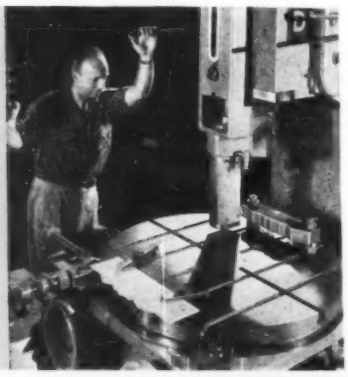
# tracing and conventional slotting

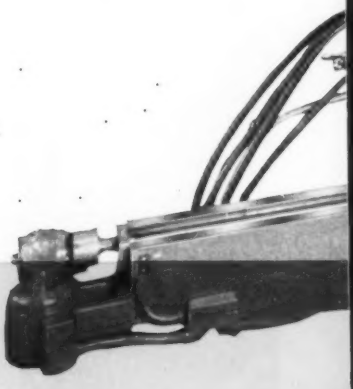
Here's a powerful new Hy-Draulic Slotter capable of doing both conventional slotting and complicated tracing work. Rotary tracing and straight work are handled by a transverse movement of the saddle. Equipped with a highly sensitive, precision-engineered Kopy-Kat Duplicator, this slotter will actually produce its own working templates from a toolroom master, or from a finished workpiece.

Design features of this versatile new machine include powerful fulcrum drive to the ram, hydraulic feeds and power rapid traverse in all directions, and pendant controlled cutting speed changes.

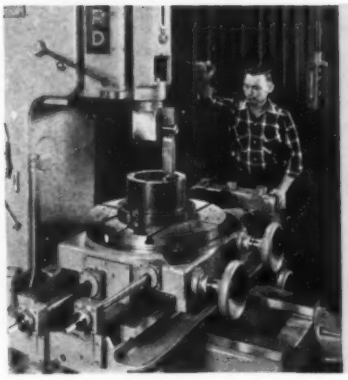
See your Rockford Machine Tool Co. representative, or write us directly, for the complete information on this new Hy-Draulic Slotter.

tracing



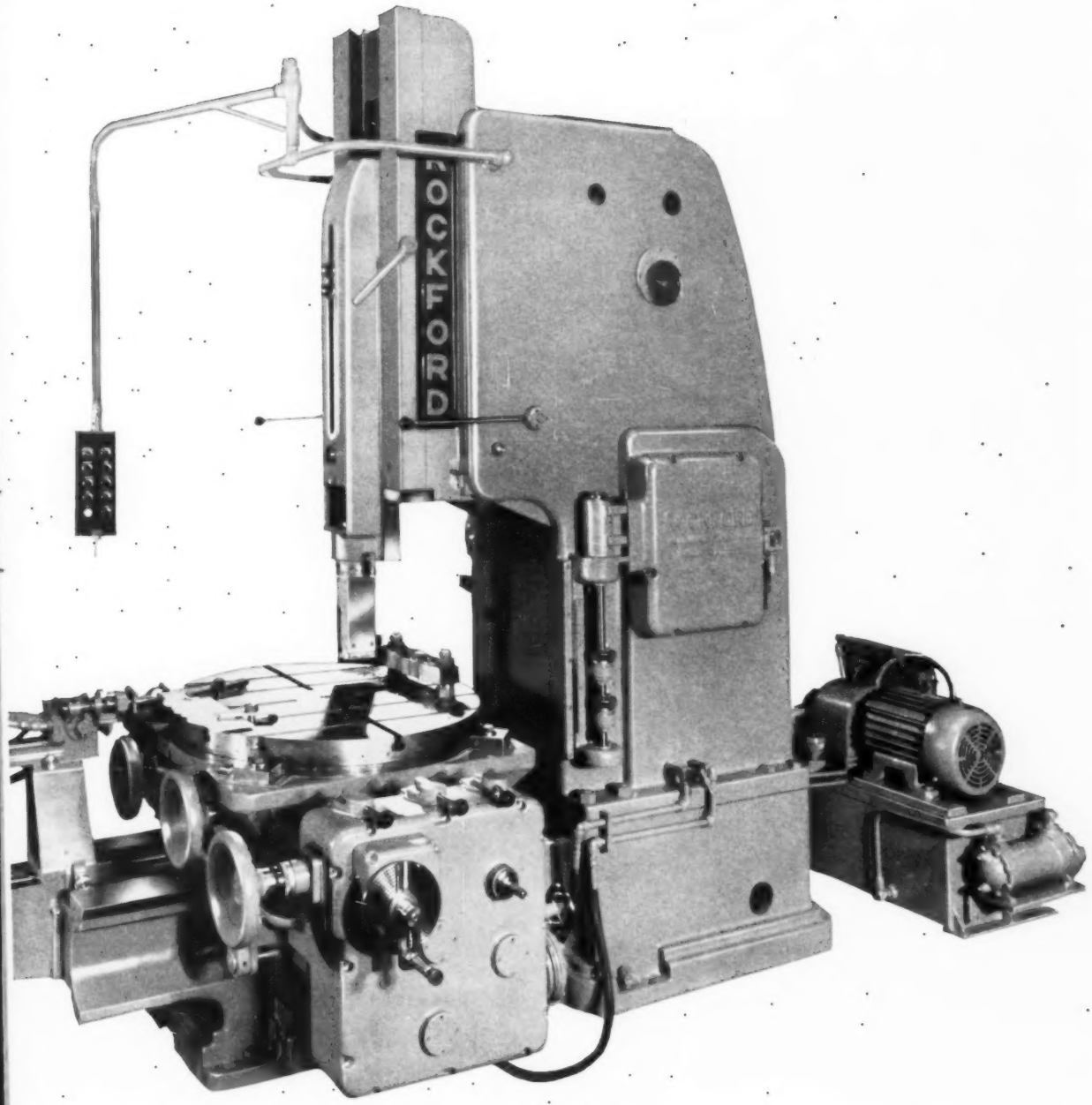


conventional slotting





MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**



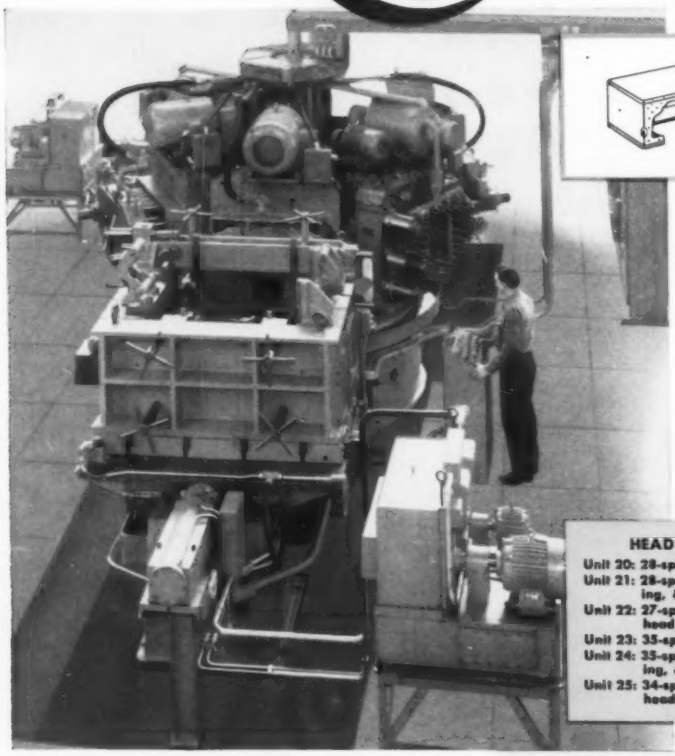

ROCKFORD MACHINE TOOL CO.

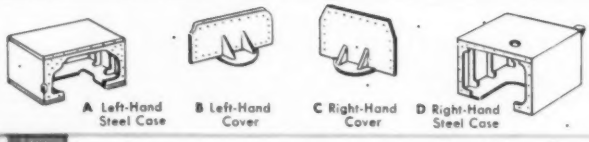
2500 KISHWAUKEE STREET • ROCKFORD, ILLINOIS

CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**

# NEW W. F. & JOHN BARNES STANDARD Versa-Matics

Patents Pending





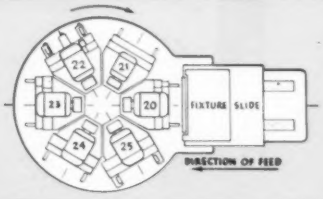

## MACHINE No. 1

Standard Barnes "Versa-Matic" with 6-Station Rotary Table and Shuttle-Type Work Holding Fixture. Drills, reams, chamfers, and taps workpieces A, B, C, D, and E.

**Approx. Loading Time per piece** ..... 3.00 min.
**Approx. Unloading Time per piece** ..... 2.00 min.
**Gross Production (100% efficiency):**
Case Parts ..... 6.55 per hr.
Cover Parts ..... 9.50 per hr.

**HEAD OPERATIONS**

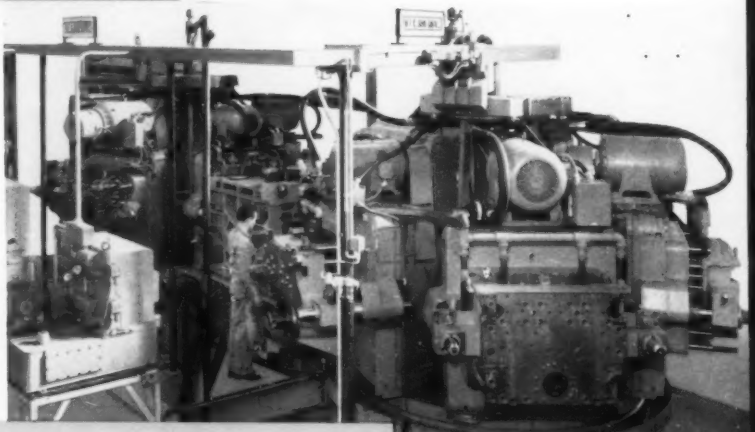
**Unit 20:** 28-spindle drilling head
**Unit 21:** 28-spindle chamfering, reaming, & counterboring head.
**Unit 22:** 27-spindle tapping & milling head
**Unit 23:** 33-spindle drilling head
**Unit 24:** 33-spindle chamfering, reaming, & counterboring head
**Unit 25:** 34-spindle tapping & reaming head

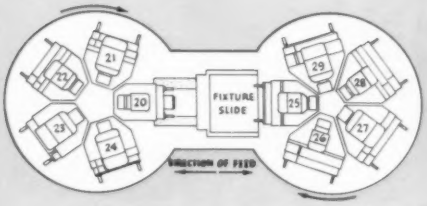



## MACHINE No. 2

Standard Barnes "Versa-Matic" with Two Five-Station Rotary Tables and Shuttle-Type Work Holding Fixture. Drills, chamfers, reams, and counterbores different surfaces of same workpieces A, D, and E processed on Machine No. 1.

**Approx. Loading Time per piece** ..... 3.00 min.
**Approx. Unloading Time per piece** ..... 2.00 min.
**Gross Production (100% efficiency)** ..... 2.90 per hr.






**HEAD OPERATIONS**

**LEFT-HAND**

**Unit 20:** 19-spindle drilling & boring head
**Unit 21:** 39-spindle drilling head
**Unit 22:** 53-spindle chamfering, reaming & counter-boring head
**Unit 23:** 29-spindle tapping head
**Unit 24:** 24-spindle tapping head

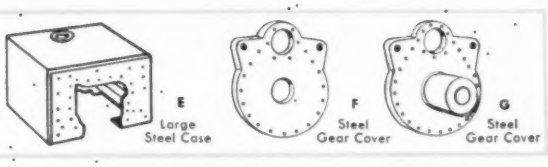
**RIGHT-HAND**

**Unit 25:** 17-spindle drilling & counterboring
**Unit 26:** 22-spindle drilling, reaming, & chamfering head
**Unit 27:** 28-spindle drilling head
**Unit 28:** 48-spindle chamfering, reaming, & counter-boring head
**Unit 29:** 46-spindle tapping head



CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

# NOW OFFER 3-WAY SAVINGS FOR SMALL LOT MACHINING




### *Versa-Matic* Design Assures Greater Efficiency on Low Production, Conserves Capital Expense and Floor Space

These new W. F. & John Barnes production machines, termed "Versa-Matics," illustrate three basic applications incorporating a new, exclusive principle in machine tool engineering which now makes possible substantial savings in handling a broad range of low production work. They are designed with standard indexing tables mounting multiple-spindle heads, and are equipped with quick locating fixtures and shuttle-type feed units that move the work to the tools. Electrical contact devices for each station are mounted overhead, and are the self-cleaning type. Contacts are fully interlocked and enclosed when in operation, with remaining contacts de-energized when out of operation. The versatility of these new machines with capacity for handling more than one workpiece, offer three-way savings. For example, for a road equipment manufacturer, machines illustrated provided up to 80% savings in floor space over any other processing method, and reduced equipment cost up to 50%. Handling many operations simultaneously, achieved high efficiency with less work handling. Now, for larger and smaller work, the new Barnes "Versa-Matics" are available in a range of standard sizes to serve your specific production requirement.

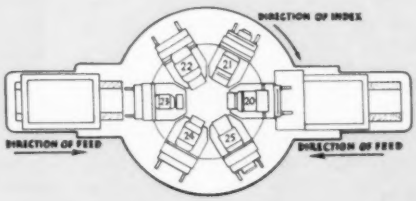
**MACHINE No. 3**

Standard Barnes "Versa-Matic" with Center 6-Station Rotary Table and Two Shuttle-Type Work Holding Fixtures. Drills, bores, chamfers, and taps same workpieces A, D, and E processed in Machine No. 1 and 2, and also workpieces F and G.

| | Case Parts | Gear Covers |
|---|---|---|
| Approx. Loading Time per piece | 3.00 min. | 2.00 min. |
| Approx. Unloading Time | 2.00 min. | 1.00 min. |
| Gross Production (100% E.) | 4.73 per hr. | 5.00 per hr. |

**HEAD OPERATIONS**

- Unit 20: 4-spindle semi-finish boring head
- Unit 21: 4-spindle semi-finish boring head
- Unit 22: 21-spindle drilling head
- Unit 23: 21-spindle chamfering head
- Unit 24: 13-spindle tapping head
- Unit 25: 4-spindle finish-boring head




**WRITE FOR MORE DATA**

If you have similar small lot work requiring multiple machining operations where competitive costs must be maintained, it will pay you to get full facts today on the new Barnes standard "Versa-Matics." Cost analysis will be gladly rendered without obligation.

W. F. & JOHN BARNES

Builders of Better Machines Since 1872

**W. F. & JOHN BARNES COMPANY**

402 SOUTH WATER STREET • ROCKFORD, ILLINOIS

*Multiple Spindle Drilling • Boring • Tapping Machines • Automatic Progress-Thru Transfer-Type Machines*

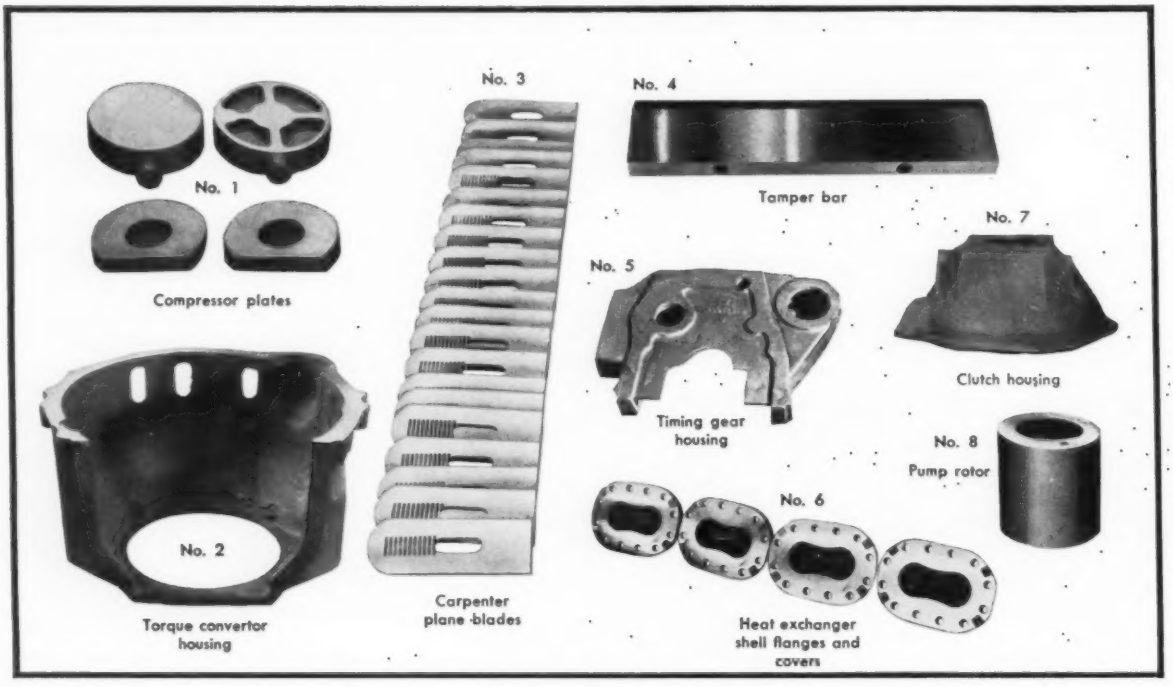


FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

MATTISON
HIGH-POWERED PRECISION
GRINDING METHODS

# Here are 8 strikingly profitable jobs

## . . . done on standard surface grinders!




### Are your profits pegged by machines you bought 20 years ago?

When there's a change in the "economics" between one machining method and another, do your profits change, too?

Or are they pegged by rising costs and fixed productivity of machines you bought 20 years ago! Surface grinding "economics" has been changing fast, partly because of improved grinding wheels, and striking profit improvements have resulted for manufacturers who have re-evaluated conventional methods of 10 or 20 years ago.

Some shops haven't recognized the fact that surface grinding is an efficient and fast stock removal operation. But it is . . . and as such, it gives you a roughing method that combines the advantages of high initial accuracy, easier cutting through outer scale and hard spots, and valuable material savings due to reduced stock allowances. Of significance to you are the resultant opportunities to reduce costs, particularly those associated with the actual cutting of metal, such as down-time for tool changes, tool breakage, tool sharpening, resetting, cutting fluid carry-off, chip disposal, etc.

You may not have thought of it this way, but it is important to take into account the fact that a grinding machine *sharpens its own cutters*. By using open-structure wheels which automatically release their grits when they get dull, and with automatic work sizing to compensate for wheel wear, you never have to stop your surface grinder to service the cutting tool. The only perishable tool cost is wheel depreciation per piece. Thus, savings in tool replacement cost alone often pay for a new surface grinder. A glance at the jobs illustrated will show you how.

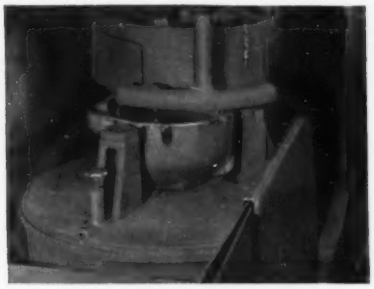
**JOB NO. 1**—*High efficiency*

Continuous, single-pass grinding at 4800 surfaces per eight-hour shift on this five-spindle rotary automatic, plus self-dressing wheels and automatic sizing, eliminated nonproductive machine time. Two different cast iron compressor parts are ground from the rough, holding flatness and parallelism within .001 in. Stock removal is .077 in. per side. Former production was only 1200 surfaces per shift.



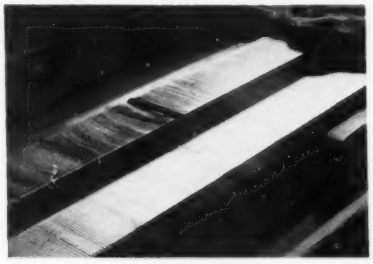
MACHINES DESIGNED TO MEET YOUR NEEDS ROCKFORD, ILLINOIS, U.S.A.

**JOB NO. 2**—*Two operations eliminated*



The open section in these torque convertor housings made them difficult to mill without springing the ends. Top and bottom surfaces are now being ground from the rough, eliminating two milling operations on each surface. Production is 17.4 pieces per hour. Stock removal is .060 in. to .070 in. per side. Flatness and parallelism are easily held within the .0015 in. tolerance. There's no downtime because wheels are self-dressing and the operator loads one table while the work is being ground on the other.

**JOB NO. 3**—*Cost reduced four ways*



Striking savings were made possible by reducing setup time from nine hours to ½ hour; machine maintenance was reduced; wheel replacement cost was minimized; and production of hardened steel blades at the rate of 1750 per hour was achieved from four Mattison surface grinders against eight machines formerly required for the same work. Parts are stacked on magnetic chucks. Stock removal is .012 in. per side.

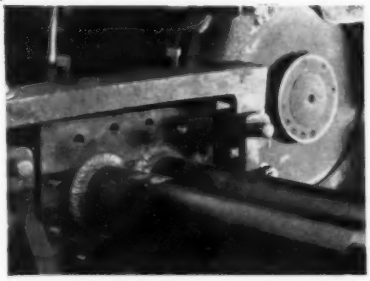
**JOB NO. 4**—*Production boosted 26%*

The average production increase for three different grinding operations on heat-treated 52100 (54-57 Rockwell, C) steel tamper bars is 26 per cent over the former method because of larger contact area of the segmental wheel, plus high horsepower of the spindle motor for removing stock efficiently and fast. Rejects have been eliminated because the grinder easily holds flatness within the .005 in. tolerance, and the same consistent performance is obtained whether feeding fine or taking a brute cut. No maintenance has been required since the installation of the Mattison grinder.

**JOB NO. 5**—*Production rate doubled*

More pieces per table load, faster setup on the magnetic chuck, and high stock removal rate on the vertical-spindle surface grinder boosted production of these timing gear housings from 5 to 12 per hour over milling. Parts are first rough ground to within .010 in. on both sides and then finished on the same machine. This eliminates warpage and increases accuracy.

**JOB NO. 6**—*$3500 material saved*



A 10 per cent reduction in stock allowances after these heat exchanger shell flanges and covers were switched from milling to grinding produced a saving of $ .228 per part in material cost alone. In addition, one operator now grinds the same amount of production as two men formerly machined on two boring mills. This released one operator and two mills for other work. Carbon steel flanges on the ends of large, awkward tubes can be ground on the same traveling-wheel face grinder that grinds the cast steel covers (held in a two-position rotary fixture). The grinder produces a gasket fit that prevents leakage at tube pressures up to 5,000 psi. Stock removal is 1/16 in., and flatness is held within .003 in.

**JOB NO. 7**—*Three operations eliminated*

Formerly, the transmission and motor faces of these clutch housings were machined by two grinding and two milling machines. After putting them on a multiple-spindle, single-pass rotary surface grinder, rough and finish machining was combined in one setup, increasing production from 40 to 80 housings per hour. It now takes only 30 minutes to set up the grinder (mostly to change wheel segments) compared with a change-over time of from 1½ to 2 hours on the former equipment. Stock removal is ⅛ in. per side; flatness and parallelism are held within .004 in.

**JOB NO. 8**—*Assembly speeded*

Parts for scientific apparatus are now being assembled much faster due to increased accuracy of the Mattison horizontal-spindle surface grinder, and production has been increased 100 per cent over the former method. The semi-steel pump rotors shown, for example, are held flat and parallel within .0003 in. Production rate is 50 pieces per hour.

### *Try before you buy*

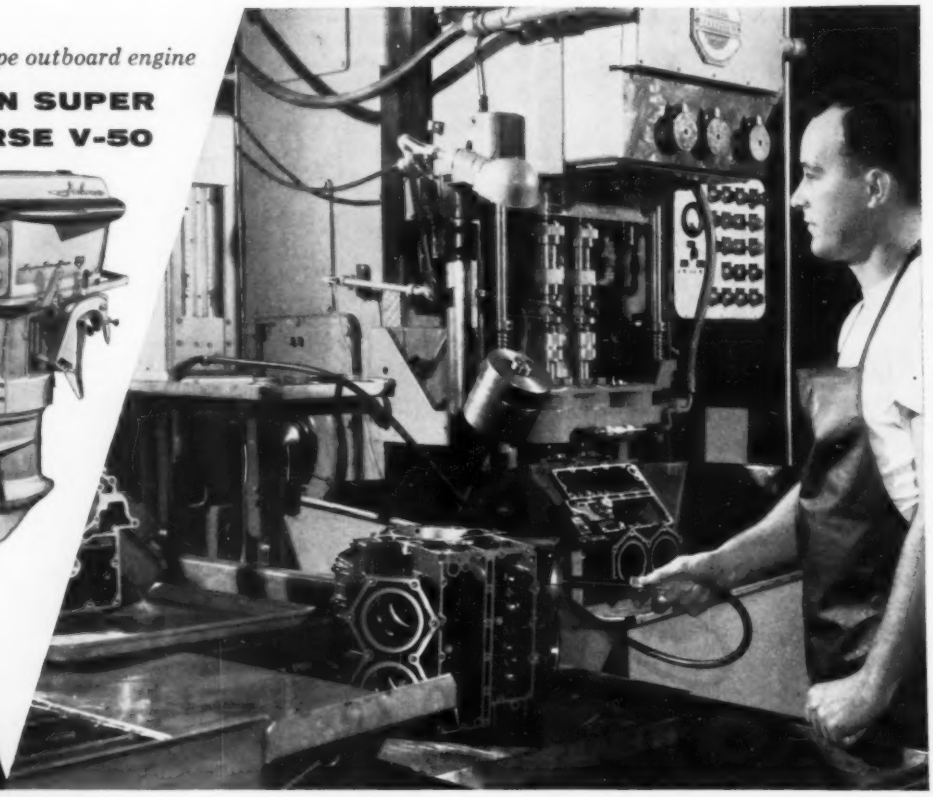
You can explore these new opportunities to increase profits without spending money. Before you buy, we offer a free evaluation of your work, including a sample grind of parts in the Mattison Methods Laboratory. From this, we will give you a complete job analysis, including wheel consumption, production rate, tooling, accuracy, finish, wheel specifications, coolants, type of machine best adapted to your work, and cost. There's no obligation—phone your Mattison dealer or the factory direct—phone 2-5521

MATTISON MACHINE WORKS
ROCKFORD ILL. U.S.A.

**MATTISON MACHINE WORKS**
**Rockford, Illinois** **Phone: 2-5521**

*world's first V-type outboard engine*

**JOHNSON SUPER SEA HORSE V-50**



## Honed on new BARNESDRIL Honing Machine!

*1.7 minutes cycle time per block, honing 4-cylinders—each with 8 ports — ±.00025" bore-to-bore size, ±.0001" roundness and taper, 38-45 RMS finish.*

This BarnesdriL Honing Machine, located in the Waukegan plant of Johnson Motors, is arranged for conveyor-line production and automatically sizes and finishes cylinder bores of two different V-engine aluminum blocks with integral cast-iron sleeves. Operator has convenient pushbutton control of the machine and trunnion-type fixturing for production line efficiency. The machine accomodates the two different blocks through 3-spindle head and hydraulic lateral index to locate proper offset between the cylinder banks.

Cycle time of 1.7 minutes includes Plugmatic bore-to-bore sizing and dwell for positive depth blind-end honing. Size, straightness and roundness over 8 ports in each bore are consistently controlled by BarnesdriL electronic hone expansion, plugmatic bore-to-bore sizing, and automatic compensation for stone wear.

If you have high-quality-bore production problems, consult BarnesdriL engineers for production line and quality control. Estimates furnished with no obligation. Send part samples or drawings.

**BARNES DRILL CO.**

820 CHESTNUT STREET • ROCKFORD, ILLINOIS
DETROIT OFFICE: 13121 Puritan Avenue



MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

# *so quiet...*

## Just one of the reasons these electric motor manufacturers use Hoover Quality Ball Bearings

Allis-Chalmers Manufacturing Company
The Louis Allis Co.
Baldor Electric Company
The Brown-Brockmeyer Company
Century Electric Company
Cleveland Electric Motor Company
Continental Electric Co., Inc.
Diehl Manufacturing Co.
Doerr Electric Corporation
Electro Dynamic
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Elliott Company
Emerald Motor & Mfg. Co.
Emerson Electric Mfg. Co.
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General Electric Company
Howell Electric Motors Company
The Ideal Electric and Manufacturing Company
The Imperial Electric Company
Iron Fireman Manufacturing Co.
Jack & Heintz, Inc.
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The Leland Electric Co.

The Lima Electric Motor Co., Inc.
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Marathon Electric Manufacturing Corporation
Marble-Card Electric Corporation
The Master Electric Company
Oak Electric Motors, Inc.
Packard Electric Division
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The Piqua Machine & Manufacturing Co.
The Reliance Electric & Engineering Company
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American Electric Motors
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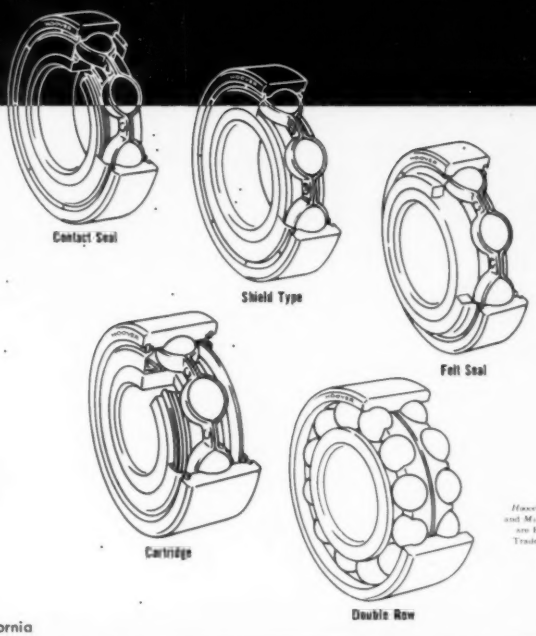
Oster Manufacturing Company
Dayton Electric Service Co.

Constantly sought by manufacturers and users is velvet smooth operation of electric motors that whispers "*superb quality*."

In many leading makes of motors, as well as other products, hushed quietness is assured through the use of Hoover Quality Ball Bearings. Precision made with super smooth *Hoover Honed* Raceways and perfectly matched *Micro-Velvet* Balls, Hoover Ball Bearings are exceptionally quiet, exceptionally dependable, exceptionally long lived.

You, too, can put these Hoover advantages to work . . . in the products you build, in the equipment you operate.




# hoover

**BALL AND BEARING COMPANY**
**ANN ARBOR, MICHIGAN**
Los Angeles Sales Office and Warehouse: 2020 South Figueroa, Los Angeles 7, California

*Hoover Honed* and *Micro-Velvet* are Hoover Trademarks

Please send the literature checked:

**Bulletin 100**—Lubricated-for-life ball bearings with seals of TEFLON*.

**Hoover Handi-Book** of Anti-Friction Bearings which outlines bearing types, problems, applications.

**Bulletin 101**—Hoover *Micro-Velvet* Balls of chrome steel, stainless steel, brass, bronze, monel.

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Bulletin 100

Handi-Book

Bulletin 101

Hoover Ball and Bearing Company
Ann Arbor, Michigan

Name_____
Title_____
Company_____
Address_____
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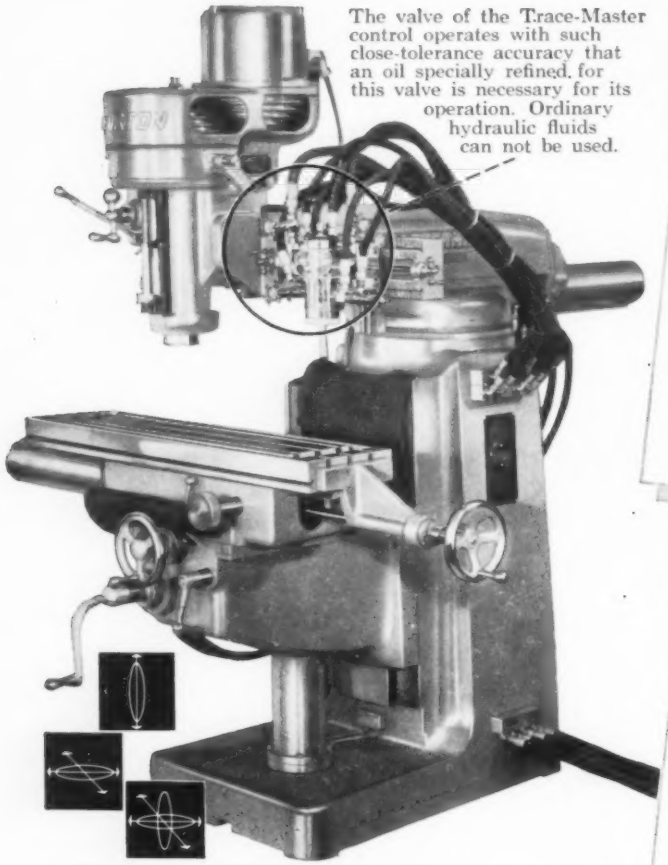
Designed for the *"Missile Age"*

# GORTON "Trace-Master" Mastermil

**with exclusive combination of sustained toolroom accuracy and precision-built Trace-Master Hydraulic tracer control**



The valve of the Trace-Master control operates with such close-tolerance accuracy that an oil specially refined for this valve is necessary for its operation. Ordinary hydraulic fluids can not be used.

**Nowhere Else** will you find this combination

1. TWO H.P. spindle motor
2. Finest Milling Head in its class
3. 80 to 5,600 RPM spindle speeds
4. Rigidity . . . (2,800 lbs net weight)
5. Extra long saddle

**Nowhere Else** will you find this versatility

1. Production profiling
2. Scanning
3. Duplicating . . . die and mold work
4. Milling . . . conventional and climb
5. Boring

***3 Models Available*** (1) 180° Vertical Hydraulic Feed to Knee (2) 360° Cross Hydraulic Feed to Ram and Longitudinal Hydraulic Feed to Table (3) 3D Hydraulic feed to knee, ram and table for 3-dimensional work.

Trace-Master controls can be furnished with the Model 1-22 Mastermil illustrated above or the Model 9-J Super-Speed Vertical Mill with single spindle, twin spindles and/or six inch higher column for additional vertical capacity.

Write for Bulletin 2771-1307

GORTON

SINCE 1893

GEORGE GORTON MACHINE CO.

1307 Racine Street • Racine, Wisconsin

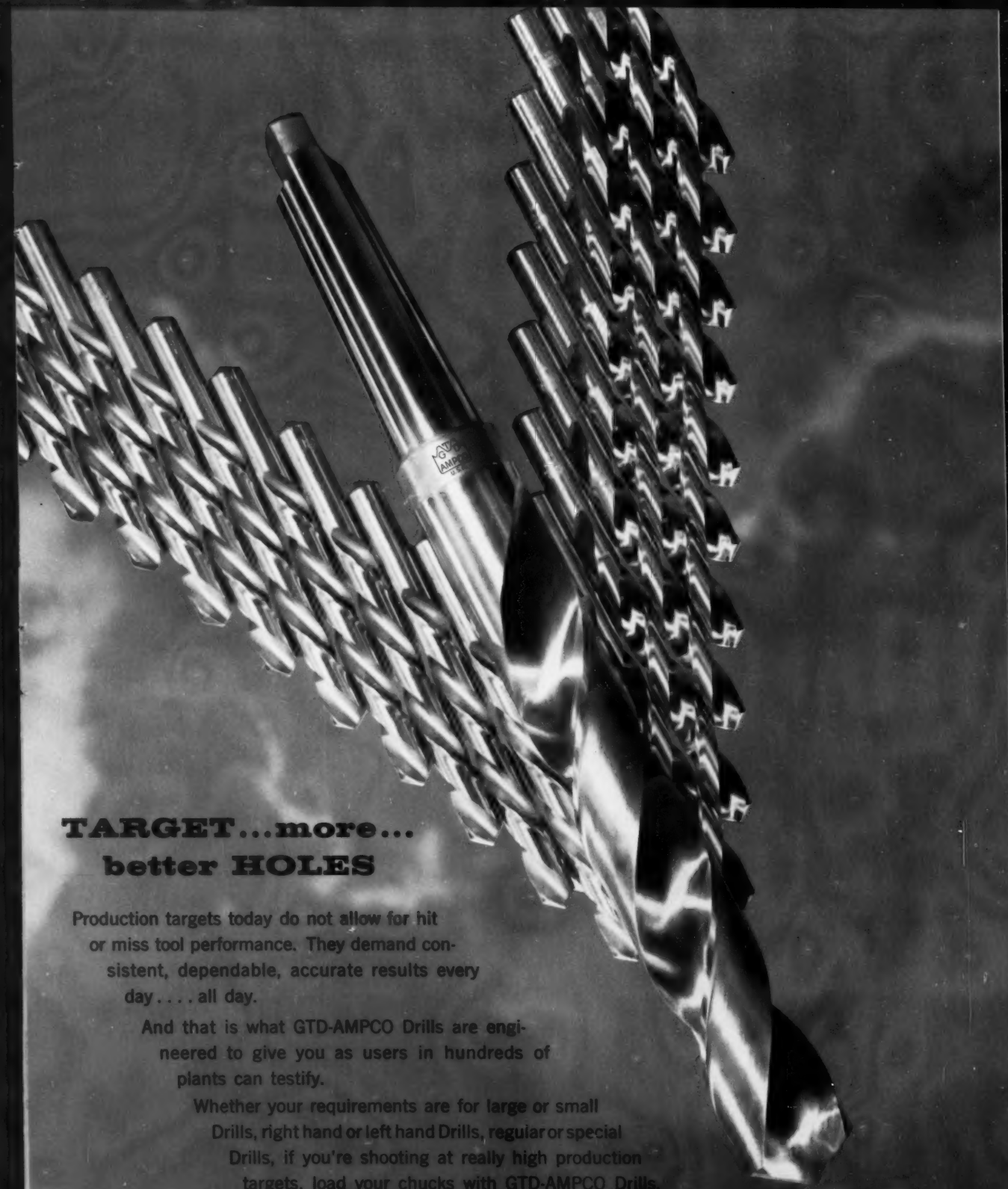
56-2

Tracer-Controlled Pantographs, Duplicators — standard and special . . . Horizontal and Vertical Mills, Swiss-Type Screw Machines, Tool Grinders, Small Tools and Accessories.

A8-1007



For more information fill in page number on Inquiry Card, on page 197



# TARGET...more... better HOLES

Production targets today do not allow for hit or miss tool performance. They demand consistent, dependable, accurate results every day.... all day.

And that is what GTD-AMPCO Drills are engineered to give you as users in hundreds of plants can testify.

Whether your requirements are for large or small Drills, right hand or left hand Drills, regular or special Drills, if you're shooting at really high production targets, load your chucks with GTD-AMPCO Drills.

**GREENFIELD** TAP AND DIE CORPORATION

GREENFIELD– AMPCO DRILL DIVISION • GREENFIELD, MASSACHUSETTS

GTD GREENFIELD AMPCO

BUY FROM YOUR **GREENFIELD DISTRIBUTOR** FOR SERVICE AND QUALITY

# HELIARC Welding
## breaks the light-gage metal barrier

Welding stainless steel sheet into a smooth, streamlined shape for jet plane fuel tanks is a production job for HELIARC Welding. This method, utilizing a tungsten electrode shielded by LINDE Argon, was developed by LINDE especially for use on hard-to-weld commercial metals.

HELIARC Welding can be used either automatically or manually, in all manual welding positions. LINDE Argon in bulk or in cylinders—99.99% pure—protects the weld. Since no flux is required, joints are clean and smooth, without spatter, saving you time and money.

Get more information about HELIARC Welding. For a free copy of the booklet, "Modern Methods of Joining Metals," write Dept. MY-7. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. *In Canada:* Linde Company, Division of Union Carbide Canada Limited.

Fuel tanks for jet planes, made of thin stainless steel, are quickly assembled with smooth, clean and sound seams by HELIARC Welding, a LINDE development.

**FOR THE BEST IN ELECTRIC WELDING—LOOK TO LINDE!**

Linde TRADE-MARK

UNION CARBIDE

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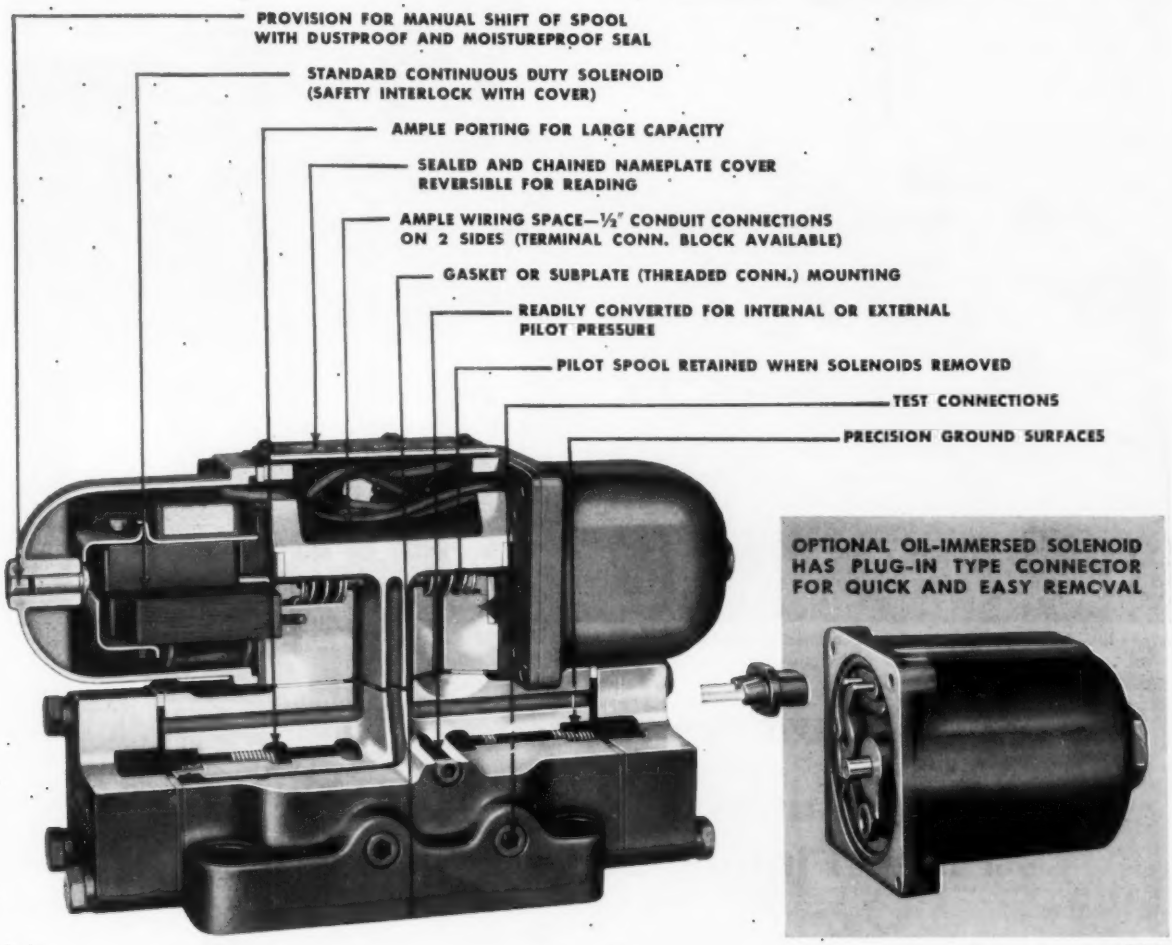
# Only VICKERS® DIRECTIONAL VALVES Have *All* These Features


PROVISION FOR MANUAL SHIFT OF SPOOL WITH DUSTPROOF AND MOISTUREPROOF SEAL
STANDARD CONTINUOUS DUTY SOLENOID (SAFETY INTERLOCK WITH COVER)
AMPLE PORTING FOR LARGE CAPACITY
SEALED AND CHAINED NAMEPLATE COVER REVERSIBLE FOR READING
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GASKET OR SUBPLATE (THREADED CONN.) MOUNTING
READILY CONVERTED FOR INTERNAL OR EXTERNAL PILOT PRESSURE
PILOT SPOOL RETAINED WHEN SOLENOIDS REMOVED
TEST CONNECTIONS
PRECISION GROUND SURFACES
OPTIONAL OIL-IMMERSED SOLENOID HAS PLUG-IN TYPE CONNECTOR FOR QUICK AND EASY REMOVAL
7897

## REDUCED DOWN-TIME
## LONGER SOLENOID LIFE
## LESS MAINTENANCE
## EASIER INSTALLATION

Vickers hydraulic 2- and 4-way valves provide the optimum in directional control. They are compact, versatile, and are designed for heavy duty, continuous and rapid cycling operation on all types of industrial machinery. More than a decade of application experience and years of research and development back all the valves' features.

Seven spool types satisfy a wide variety of circuit needs and operate at pressures to 3000 psi. Optional oil-immersed solenoids operate cooler, increasing service life 20 to 30 times.

Installation is simplified with ease of wiring and a minimum of piping. The valves are available for gasket or sub-plate mounting. Mounting position is unrestricted except in "no-spring" models. The optional oil-immersed solenoid has a plug-in type connector and is available in all standard voltages. Field modification of existing units can be made to incorporate heavy-duty, oil-immersed solenoids.

The valves conform to JIC Standards and are available in ⅛" and ¼" direct solenoid operated models . . . ¾", 1¼", 2", and 3" solenoid controlled pilot operated models. These valves cover the flow range from 1.25 gpm to 320 gpm.

For further information, write for Installation Drawing I-182412.

**VICKERS INCORPORATED**
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
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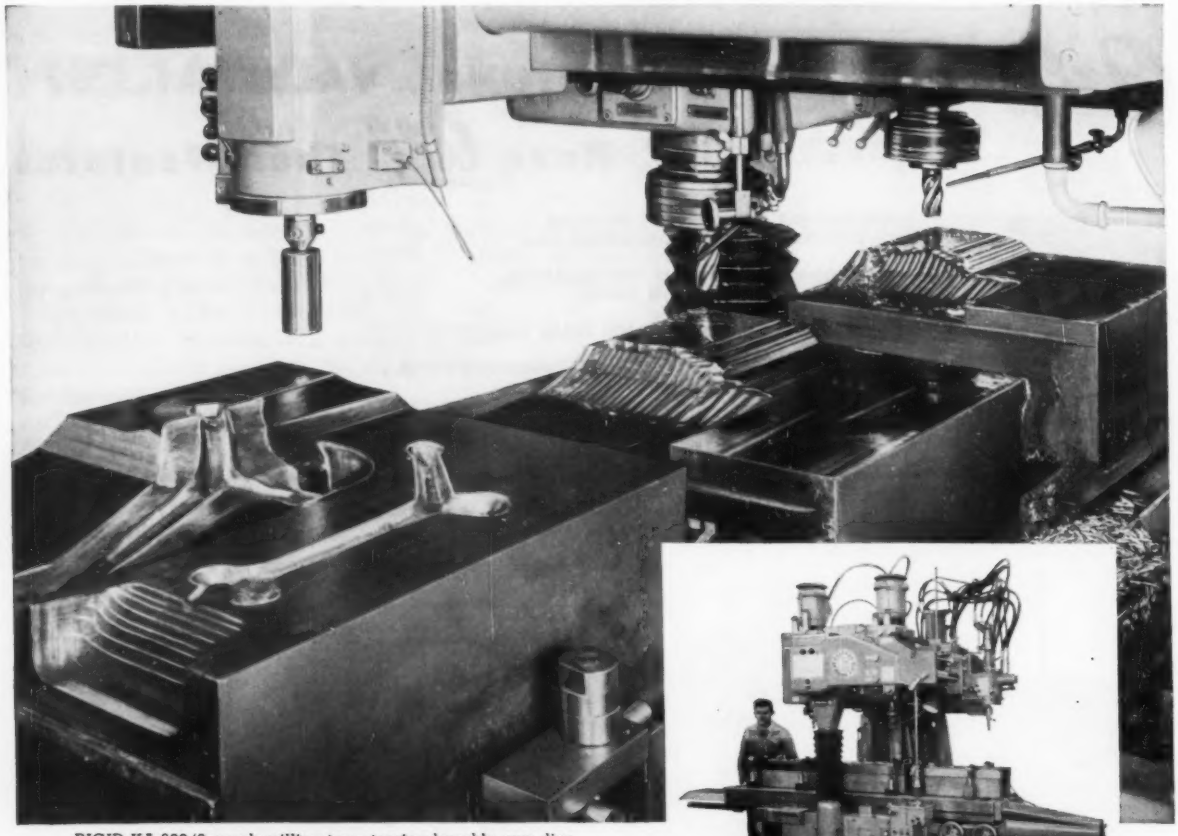
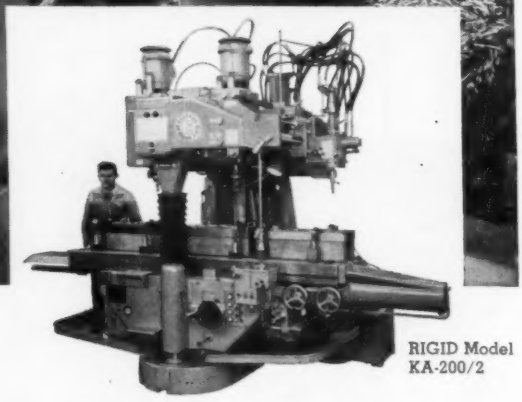


RIGID KA-200/2 rough milling two steering knuckle arm dies



RIGID Model KA-200/2

**Rigid** *Provides—*

# Fully Automatic Die-Sinking Finer Finish, Less Bench Time

A great improvement in accuracy and surface finish—with no increase in cutting time—is possible with these RIGID Die-Sinking and Hydrocopy Milling machines. Fully automatic machining permits a drastic cut in operator's supervision. Accuracy and high surface finish keep bench time to an absolute minimum—in many cases only polishing is necessary. A completely enclosed frame gives the machine tremendous rigidity to handle extremely heavy cuts. The RIGID is available in three sizes with 1, 2, 4 or 6 spindles. Largest copying area is 23⅝" x 39⅞".

**OTHER RIGID FEATURES**

- Normal Working Accuracy of ±.002" or Closer
- Completely Vertical Copying, Up or Down
- Constant Surface Feed Over Any Contour
- Hand Control for Roughing
- Reverse Image Attachment
- Automatic 360° Profiler With Depth Control (Working Accuracy ±.002")
- Change-over from Transverse to Longitudinal Copy-Milling in Seconds

**Write For Additional Information**

**COSA** — *nationwide sales and service of precision machine tools —from bench lathes to boring mills.*

COSA CORPORATION, 405 LEXINGTON AVENUE, NEW YORK 17, N.Y.

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**ACHESON**

# dispersions digest

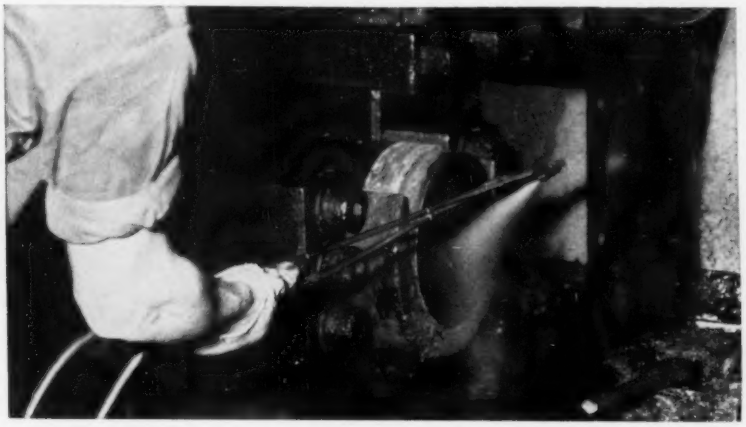
Reporting uses for

dag® BRAND DISPERSIONS

COLLOIDAL GRAPHITE, MOLY-SULFIDE, VERMICULITE, AND OTHER SOLIDS

## WHY 'DAG' DISPERSIONS MEAN *PERFORMANCE* IN ALUMINUM EXTRUDING

**The excellent lubricating properties of Acheson Colloidal Graphite, under conditions of extreme heat and pressure have been confirmed by leading extruders of aluminum, steel, copper, brass, lead and other metals. Water-base dispersions of colloidal graphite used in the following application histories have provided savings in material handling, reduced maintenance time and expense, prevented seizure, extended die life, and produced extrusions of more uniformly high quality. Any one of these benefits should make profitable reading for you.**



For faster, more uniform application with less material consumption, Aluminum Extrusions, Inc. finds 'Aquadag' their best die lubricant.

***A little 'Aquadag' goes a long way*** for Aluminum Extrusions, Inc., Charlotte, Michigan. This company, one of the leading independent extruders in the country, has found that by applying 'Aquadag' on die surfaces they have effected a 30% savings in their material handling. Formerly, they had used an oil-graphite mixture which required a dilution ratio of 16 lbs. of graphite to a 55 gallon drum of oil. It was too slowly applied by swab and too coarse to apply by spray with any degree of efficiency.

With 'Aquadag', Aluminum Extrusions has a lubricant that is finer in particle size, permits wider coverage, and provides greater "sprayability". These minute particles pass freely through the spray nozzle, eliminating the costly downtime formerly involved in cleaning clogged equipment. The tough, dry film 'Aquadag' forms upon the evaporation of its water carrier, doesn't smoke or react when applied to hot dies and metals. This improves working conditions as well as extends die life. Important also to both die surfaces as well as the finished extrusion, is the fact that this durable, low-friction film allows easier, more uniform metal flow.

Considered in relation to the over 12 million pounds of aluminum extruded yearly at this plant . . . 85% of it in fabricated form . . . *'Aquadag' has brought important production efficiencies and material economy* to Aluminum Extrusions, Inc. In many, similar instances where product quality and basic economy are demanded, Acheson colloidal dispersions have gained ready acceptance.

Exclusive Acheson processing techniques guarantee a consistently uniform top-quality product. If your problem is more effective lubrication under normally adverse conditions of extreme temperature, pressures, or abrasion, call in your Acheson Service Engineer.

Extended die life and extrusions with more perfect surface finish, are attributed to the use of 'Aquadag'.

***Dies last three times longer with 'Aquadag',*** according to another prominent midwest extruder. Metal pickup on the extruding dies has been completely eliminated by the use of this Acheson dispersion, extending the effective use of the dies from 1000 to 3000 strokes. The evaporation of its water-base leaves a dry, adherent "graphoid" film on all lubricated surfaces, inhibiting the build-up of abrasive precipitates. At the same time, the unbroken, microscopically-thin film that 'Aquadag' provides, facilitates metal flow and reduces scoring to a negligible minimum. Application of the lubricant is by spraying a dilution of 1 part 'Aquadag' to 20 parts water, on the die surface before each "push" of the extrusion press.

A 'dag' graphite coating is also applied to the follow blocks on this company's 1400 ton horizontal extrusion presses. For purposes of even greater economy, 'Prodag' — semi-colloidal graphite in water — is used in this application. This effective parting agent prevents the flash, back-extruded from the billet skin, from locking the butt to the follow block. An Acheson dispersion is very possibly the answer to your lubricating troubles. For additional information, write for your free copy of Bulletin 426. Address Dept. M-78.

**ACHESON** *Colloids Company*

PORT HURON, MICHIGAN

*A division of Acheson Industries, Inc.*

Also Acheson Industries (Europe) Ltd. and affiliates, London, England

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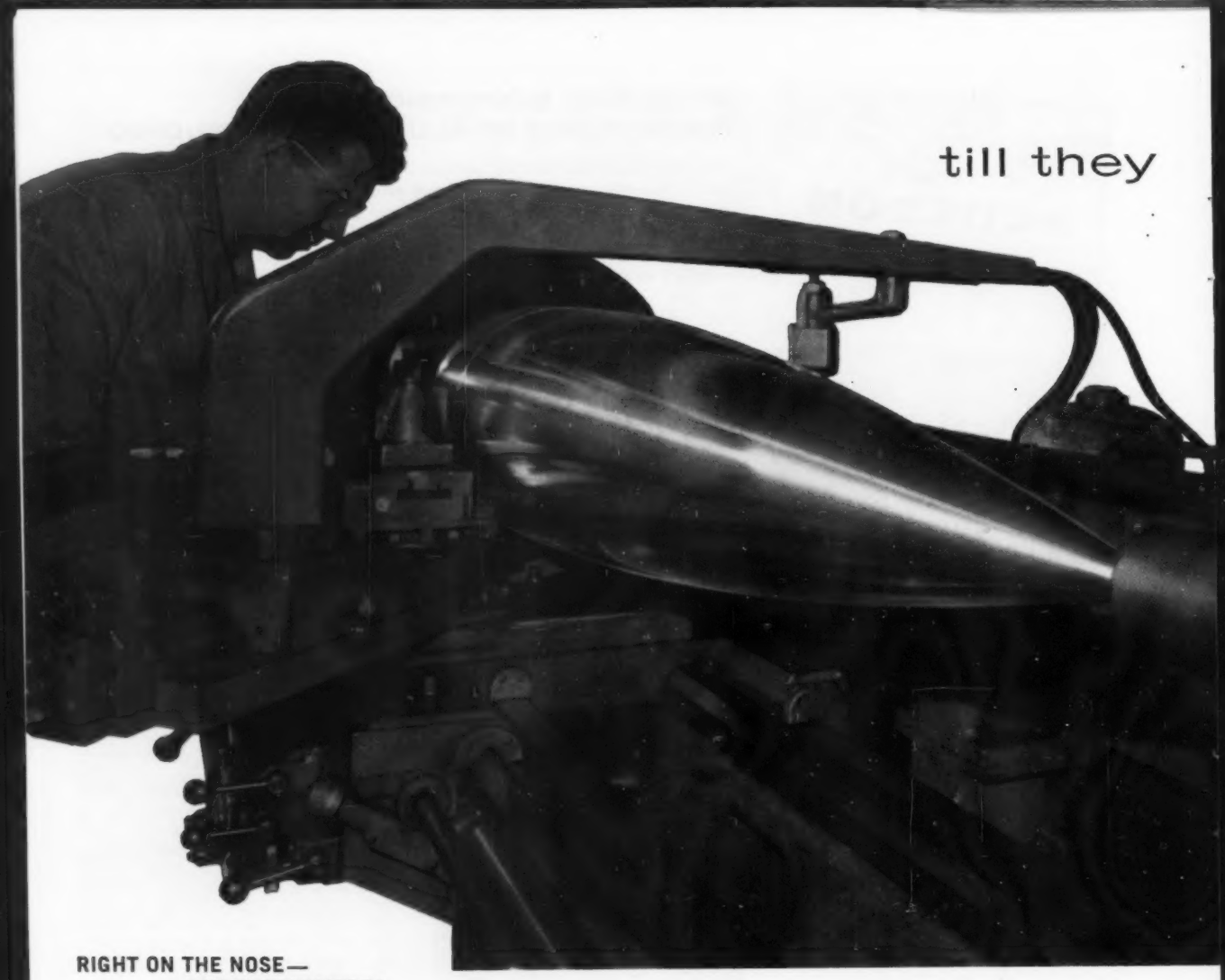
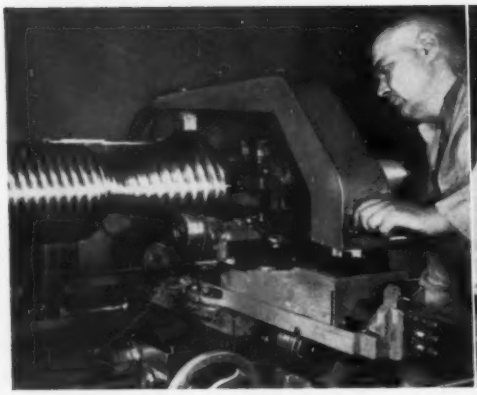
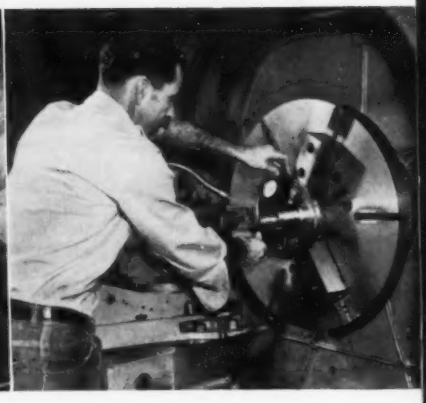



## RIGHT ON THE NOSE— AND EVERYWHERE!

Grinding complex missile shapes, in many cases, would be either costly, difficult, impossible or all three. Monarch Air-Gage Tracer users produce finishes of 17-18 micro-inches **regularly**—some of which are polished to 2-3 micro inches. Good enough—and no grinding problem! (Above—unretouched photo of die mold for plastic nose cone turned to a 16-18 micro-inch finish)

**Monarch**
TURNING MACHINES
FOR A GOOD TURN FASTER . . . TURN TO MONARCH



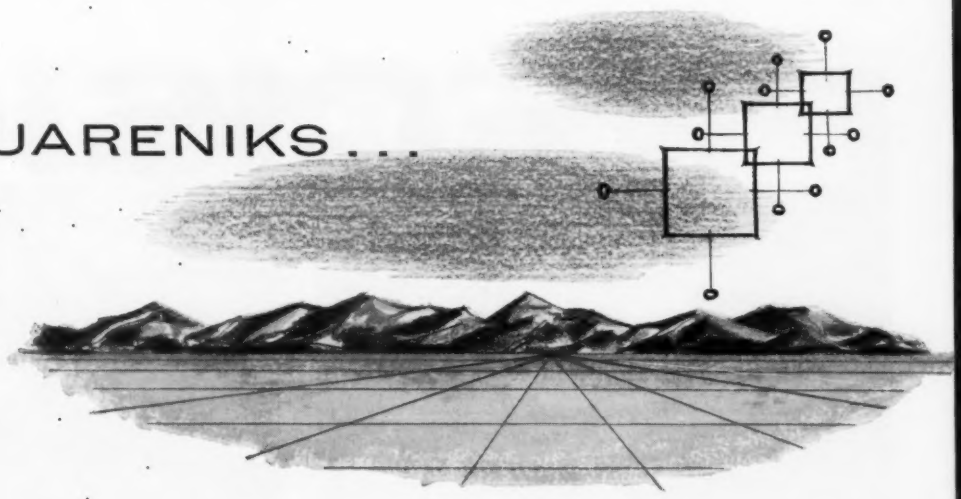


## WHAT IT TAKES:

Air-Gage Tracer Control, Swiveling Action—a Monarch exclusive. Only with this equipment can you generate—in a single machining set up—the exacting, complex, often exceedingly thin-walled contours demanded by missile hardware. Tracer-controlled single point turning is mandatory for accuracy needed for critical parallelism, squareness and concentricity—and cheaper, too! (above a helix combustion chamber)

## GREAT ON THE FACE OF IT

Numerous Monarch lathes afford you the advantages of constant surface cutting speed—so important to speed and finish in the facing of large, thin-walled work. Shown is a facing operation on a ram-jet turbine disc. Machine is a Monarch Model F Right Angle Lathe, swinging 60" in gap, equipped with Air-Gage Tracer Controls and constant surface cutting speed operating on both sides of center.



want SQUARENIKS . . .

# THE MONARCH SWIVELING AIR-GAGE TRACER

## is a missile and rocket making "must"

"Many jobs can be performed satisfactorily only on Monarch swiveling Air-Gage Tracer lathes," says one of the country's leading experts in the field.

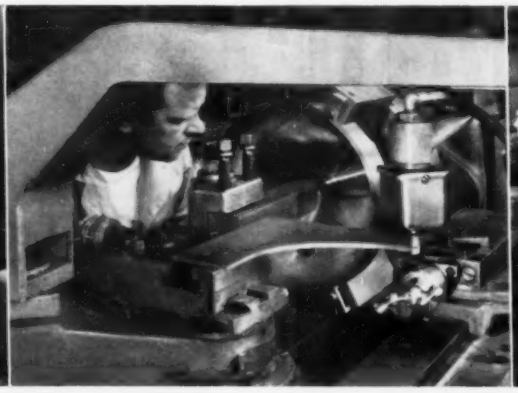
Today, missile manufacturing is in its infancy. Even so, Monarch tracer lathes have proved themselves wherever used. And that is in most plants where missile components are being produced. Both swiveling and rigid types are employed. Adaptable to such work are all sizes from the small 10" Model EE to the largest Heavy Duty Lathes, plus the Mona-Matics and the Right Angle Lathe.

Profit by the experience of others. Check the applications pictured and described below. Then ask us for the whole story. Finally, remember we are talking about the same Air-Gage Tracer that is improving production and lowering costs in thousands of plants throughout metal working.

THE MONARCH MACHINE TOOL COMPANY • SIDNEY, OHIO

**SELF-GAGING TURNING!**

This rocket propellant chamber component is simple compared to some shapes. How's to gage them? Even expensive gaging fixtures can't always fill the bill. So what? With the close repetitive accuracy of Monarch Air-Gage Tracing, intricate parts are accepted based on the accuracy of the flat template used. Light (6-8 oz.) stylus pressure precludes template wear.



**MULTI-THOUSAND DOLLAR QUESTIONS—AND EVERY ANSWER RIGHT!**

What's to do when you spoil pieces in this business? Especially ones that might cost up in the thousands before machining (Not shown, but we've seen 'em!) Cut your throat? No—rely on the .0001" constant repetitive accuracy of your Air-Gage Tracer slide movement—and don't spoil any!

**IT DON'T MEAN A THING IF IT AIN'T GOT THAT SWING**

You need size in this business now—and they're designing bigger all the time. That extra-large work can be Air-Gage Traced overall on a Monarch. The turbine housing above is a typical example. But we're not stopping here. If present Monarch sizes don't meet your actual anticipated needs, let us talk over greater swing designs with you.

# PRECISION

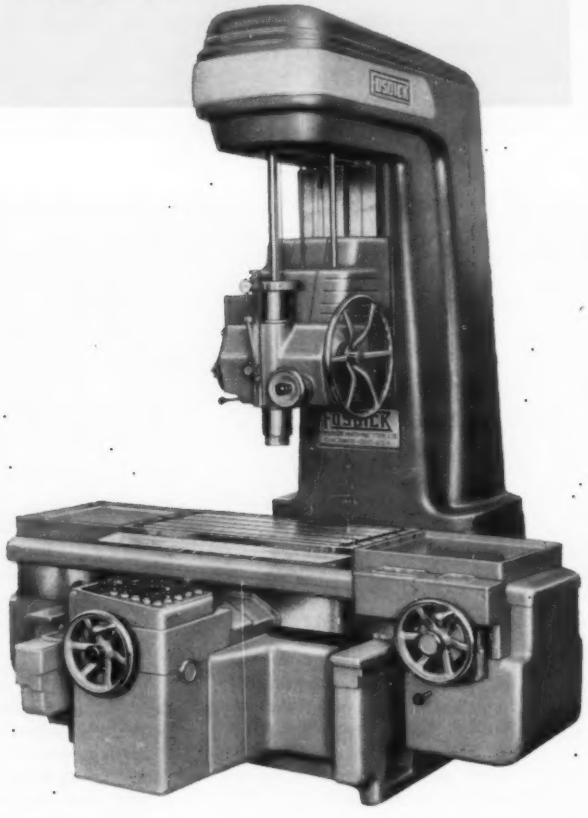
## LONG TABLE TRAVEL

Longitudinal travel — 48" Cross travel — 22"

## AUTOMATIC POSITIONING

with Direct Dimension Measuring and fast B-F Spindle tool changing

# FOSMATIC JIG BORER



# BORING

## WITH NO REJECTS

*hole location accurate to ±.0001"*

*hole sizes repeated to ±.0001"*

## SAVE 300 HOURS PER UNIT

**on precision boring of gear boxes. Each unit (2 halves) calls for over 200 holes from ¾" to 4½" dia. Boring, spot facing, recessing, milling, tapping and counter boring. Material is aluminum alloy.**

Boring time reduced from 800 hours to 500 hours per unit—with no rejects in all 50 parts—and every one accurate to ±.0001" on hole size and location! Over 200 holes per unit are machined.

Mr. R. Schmidt of Triangle Tool Co., Union, N. J., owner of this Fosmatic Jig Borer, reports, "Two Fosmatic features were largely responsible for this important time saving. First, the Fosmatic's long table travel permitted machining two parts at once. Second, the automatic positioning and Direct Dimension Measuring System work simply and fast. They eliminate confusion and help the operator work accurately and efficiently. Incidentally, that long table travel helped get us several new jobs we could never have handled on our other jig borer."

With Direct Dimension Measuring the operator sets dimensions direct from blueprint onto two direct reading drum dials. At the press of a button, the table automatically positions work to ±.0001". On the Fosmatic, this operation and all other machine functions can be numerically controlled by punched tapes or cards.

Fosmatic Jig Borers bring you many important advances in boring technology. Where progress has been so great, the obsolescence of your old machine may be more costly than you suspect. *Why not run a check?* Call your Fosdick Distributor or write us today.

*Ask for Fosmatic Jig Borer Bulletin JB-M*

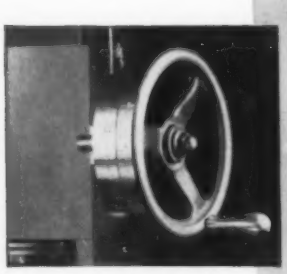
# FOOTBURT

# Accurate grinding *for small parts*

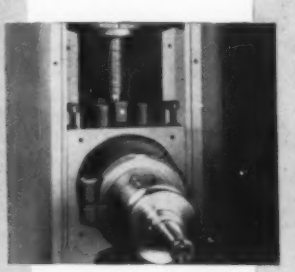
The Hammond No. 2, 6" x 18", Surface Grinder is a precision tool room machine for use on the most accurate gauge and tool work. The standard spindle is direct motor driven and is mounted on precision preloaded ball bearing. Total vertical adjustment is 10¾". In and out movement of table is 6½" with a longitudinal travel of 18".

**THE FOOTE-BURT COMPANY • Cleveland 8, Ohio**

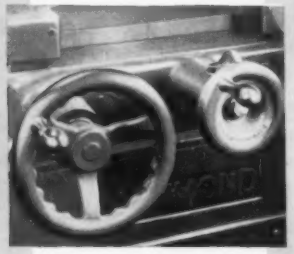
Detroit Office: 24632 Northwestern Highway, Detroit 35, Mich.



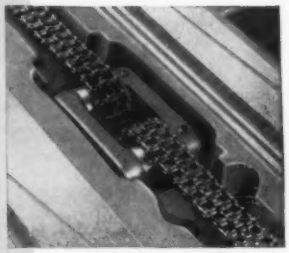
**Accurate Spindle Adjustment** — Standard vertical adjustment of spindle through handwheel is .0005". With Vernier attachment, spindle can be raised accurately to .00005".



**Solidly Supported Spindle Carrier**—Spindle carrier is moved vertically on double dovetail ways with adjustable tapered gibs.



**Convenient Hand Control** — Handy wheels for cross travel, accurately gauged to thousandths, and quick acting longitudinal travel.



**Smooth Roller Chain Table Drive**—Remarkably smooth finish on work, without chatter marks frequently found when table is moved by conventional means through rack and pinion.

# FOOTBURT

*Write for Circular #13A.*

## SURFACE GRINDING



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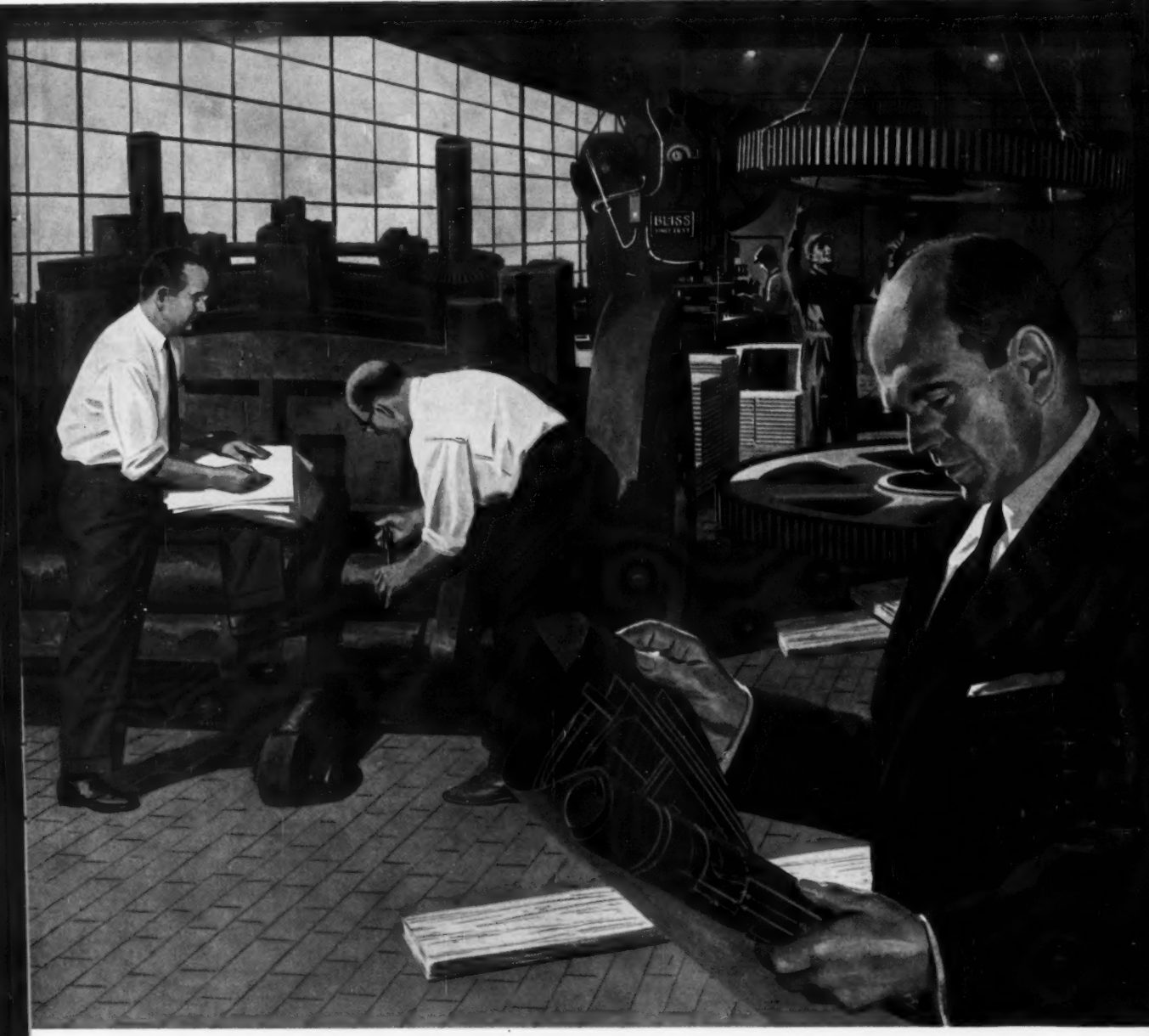


## How to breathe new life into your old presses . . .

**Modernize!** Replace the old, outdated features on your presses with brand new factory-engineered assemblies. New clutches, new slide adjustments, new bearings—these are only three of the 42 Bliss modernization assemblies you can add right in your own plant, keeping downtime and outside costs to a minimum. You can add important new press features to your old press at a fraction of the cost of a new press!

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# ELECTRONIC and ULTRASONIC quality control of MUELLER rod, tube, fabricated parts and

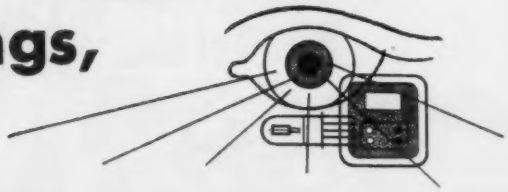
Every practical electro-mechanical testing device available to industry today is used by the Mueller Brass Co. to maintain Positive Quality Control during each manufacturing operation. From the first stages of alloying, spectroscopic analysis is used to maintain exact alloy composition so that they are precisely as specified. Ultrasonic test equipment is utilized in the non-destructive testing of extruded brass and bronze rod, copper tube, forgings and fabricated parts. In machining and finishing operations, statistical quality control is employed to eliminate the effect of possible human error. These quality controls are all designed for one purpose . . . to give you complete "product protection."

•

Copper base alloy rod is examined by a trained operator with the aid of an ultrasonic reflectoscope. Through electronic circuitry, ultrasonic echoes are translated on a cathode ray tube. Any internal flaws are readily apparent. Both rod and tube are tested by this method, which is just one of many Positive Quality Control checks used by the Mueller Brass Co.

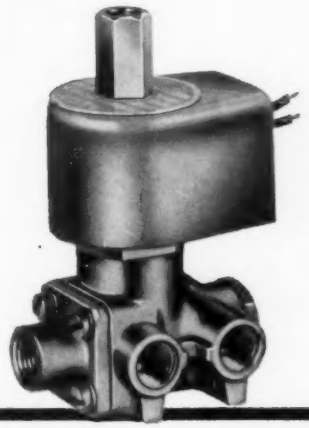
Through ultrasonics, the immerscope (Left) locates internal defects, and has exceptional versatility for examining intricately shaped parts, such as the forging being checked in this photo. When testing, a transducer, located at the bottom end of the search tube, is electronically actuated to produce from 2.2 to 25 million cycles per second. Ultrasonic echoes are reflected back to the transducer from the material, indicating any defects that may be present. Limits may be pre-established and the sound findings are visually recorded on the cathode tube. This is another instance of Positive Quality Control in action.

# TESTING helps insure positive BRASS CO. forgings, assemblies . . .



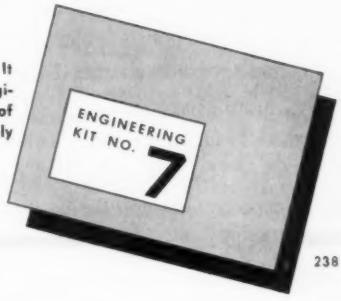
The direct reading spectrometer (Left) makes it possible to accurately analyze an alloy for chemical composition within 90 seconds while the metal is in the molten stage. A sample specimen is poured, cooled and sent to the laboratory, where it is placed in the spectrometer. Through the diffraction gratings in the machine, the "spectrum" analysis of the alloy records its exact chemical composition. With this equipment, alloy specifications are matched exactly, thus insuring a better finished product through Positive Quality Control.

THIS MIDGET 4-WAY SOLENOID VALVE (Right) is one of a complete line designed and manufactured by the Automatic Switch Co. (ASCO) of Florham Park, New Jersey. Valves of this type are used for controlling small double acting cylinders which operate valves, dampers and many types of automatically controlled equipment. One of the most important components in these valves is the non-porous brass body forged by the Mueller Brass Co. who also perform all the major machining operations so that the body is ready for use upon delivery. The forged brass body insures freedom from porosity and reduces possibility of corrosion. The Mueller Brass Co. Positive Quality Control program insures ASCO complete "product protection". . . and eliminates chance of "in-service" failures.



THIS LARGE 18" FORGED GEAR, along with two others of the same type, is used in a steam turbine installed in a power generation facility of the Wisconsin Electric Power Company, at Port Washington, Wisconsin. The gear was forged in open dies by the Mueller Brass Co. from tough, long-wearing 603 alloy. The gear operates at 25-30 RPM and is turned by the turbine, which has a capacity of 80,000 kilowatts. Strength and dependability are of utmost importance in applications like this, and in such cases Positive Quality Control insures peak performance.

**Write for your engineering kit no. 7. It contains complete laboratory and engineering data plus typical examples of Mueller Brass Co. products used in widely diversified applications.**

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## MUELLER BRASS CO. PORT HURON 27, MICHIGAN

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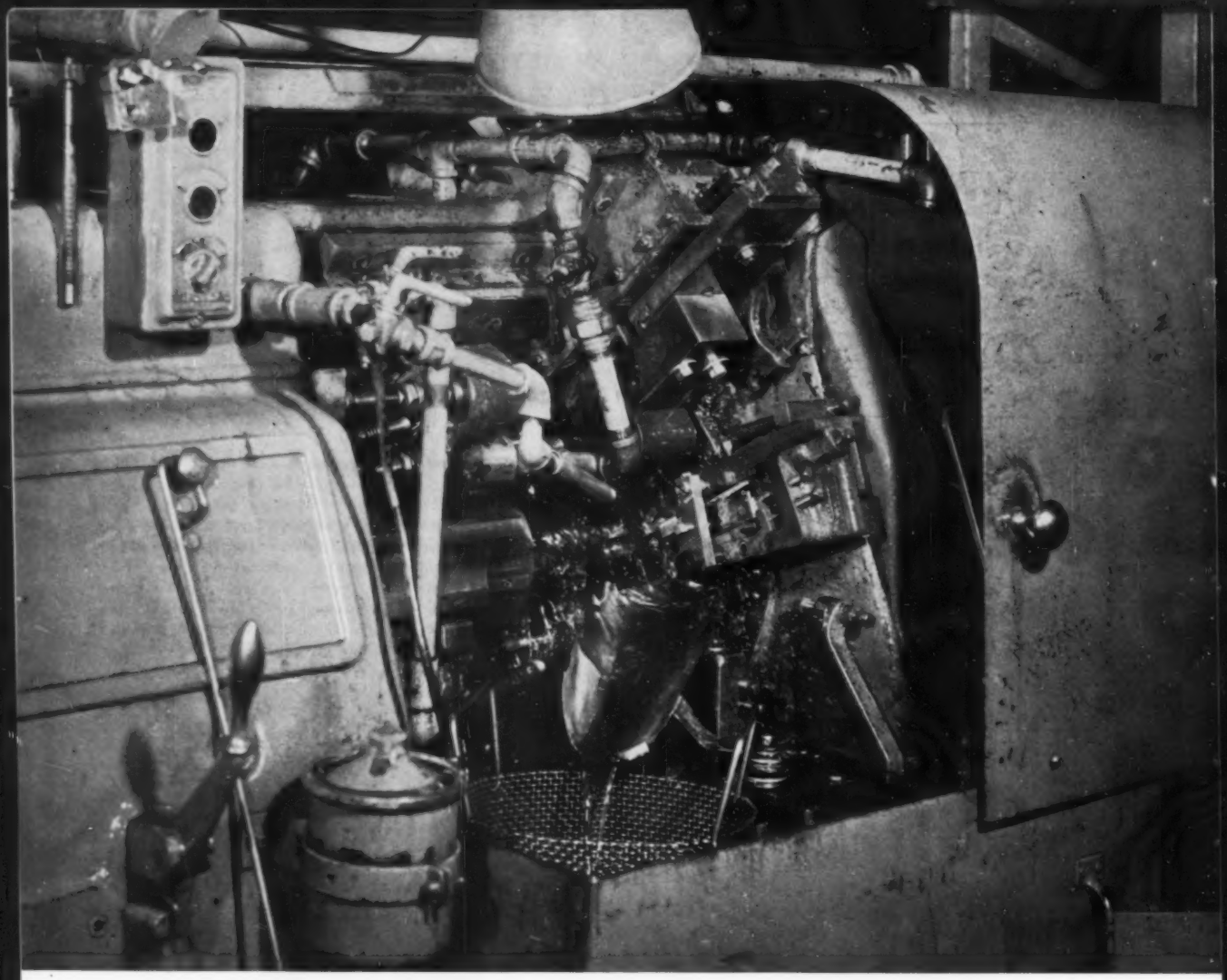


# Here's how Transultex reduces automatic screw machining costs

Texaco Transultex Cutting Oil reduces the frictional heat at the chip-tool interface. This prevents chip welding, lengthens tool life and lowers power consumption.

Transultex is transparent, and stays that way in your machines. Inspection is easier. Machined surfaces stay clean, come out with a better finish. Which means fewer rejects, more production.

Texaco Transultex Cutting Oils are part of the complete line of Texaco Cutting, Grinding and Soluble Oils, all designed to help you increase production and lower costs. Simply call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, New York.

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

- Washington Outlook Bullish
- MAPI Seeks Contract Changes
- Cost Principles Recommended
- Depreciation Easing Proposed

# Keeping up with Washington

**Loring F. Overman**

BEST OVER-ALL SUMMARY of how the Administration looks at recession problems, tax-cut proposals, defense budgets, foreign aid, and business-labor problems was to be found in the President's address before the American Management Association. Many of the Administration proposals would benefit the machinery industries directly. Following are significant observations:

**Joint Effort Urged**—"Achievement and progress cannot be created for our people; they must be created by our people.

**Plant and Equipment**—"No one is going to urge a business with ample capacity to add more facilities just because it might be good for the economy as a whole. On the other hand, very few of the 4.3 million individual businesses in this country feel that they do not need some modernization or improvement.

"What time could be better than the present for making these outlays! Government is following this simple rule: for purchases and investments that must be made anyway, acting now makes sense for the Government and gives the economy a lift. I suggest that there are numerous opportunities for private business to adapt the same principle to its operation."

**Prices, Wages, Jobs**—"Recovery must take the form, not of higher costs and prices, but of more production and more jobs. Inequities in the wage structure must, of course, be adjusted. But consumers are not going to be satisfied with less and less value per dollar of price, which is the inevitable result of less and less production per dollar of cost. If businessmen and labor leaders forget these truths, consumers will remind them in ways that are clear and painful. And in the process, the economy will suffer."

**Progress Ahead**—"Even in this recession year, business is spending more than 30 billion dollars to maintain productive equipment, expand capacity, and provide for the creation of new products. In the last five years these outlays have reached the staggering sum of 150 billion dollars. Nowhere is faith in the future better exemplified than in the 7 billion dollars which will be spent by industry on research and development—outlays that have been growing at the rate of 10 per cent a year.

"The wonders of recent years—nuclear energy, synthetics, electronics—will be dwarfed by new wonders to come. The question is going to be—not one of surmounting our problems—one of rising to our opportunities."

## MAPI Seeks Contract Changes

The Department of Defense is reported to be giving favorable consideration to proposed changes in Section 9 of the Armed Services Procurement Regulation. As proposed by the Machinery and Allied Products Institute, the changes would clarify the terms "design" and "proprietary" as applied to information required of those bidding on defense contracts.

Purpose of the change, from the standpoint of bidders, would be to safeguard "all types of valuable industrial know-how which would not normally be released by the contractor in his commercial business."

Explaining the proposal, MAPI secretary Charles I. Derr commented: "I would be inclined to observe that the interests of Government and industry in this matter of proprietary rights and technical data are not necessarily opposed one to the other. Indeed, the long-range interests of Government and industry in this field as, in fact, the entire field of Government procurement, are entirely compatible."

## Cost Principles Recommended

A comprehensive set of cost principles to replace the existing Section XV of the Armed Services Procurement Regulation has been offered to the Defense Department by the National Security Industrial Association. The proposal would standardize, for bidding purposes, items which contractors may and may not include as allowable expenses.

The proposal lists thirty-five classifications of costs suggested as properly allowable. Among recommended allowables are costs of patents, plant restoration for reconversion, rental of plant and equipment, research and development expenses, and special tooling costs.

Among those not recommended are commissions or contingent fees (by whatever name) in connection with obtaining or negotiating government contracts, except in connection with bona fide employes, or bona fide commercial or selling agencies maintained by the contractor for the purpose of securing business.

## Depreciation Easing Proposed

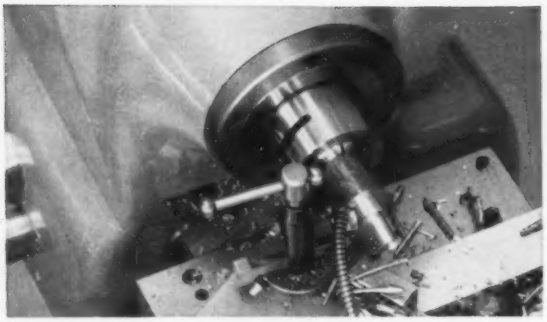
Of interest to machinery-equipment groups is Senator Homer Capehart's bill (S. 3718) proposing a speed-up of depreciation for tax purposes, of buildings or equipment constructed or acquired during 1958 and 1959. The bill proposes, retroactive to January 1, 1958, that depreciable lives of property with life expectancies up to fifteen years would be cut in half, and that a cut of two-thirds would be authorized for items with depreciable lives in excess of fifteen years.

The cut would apply to buildings, machine tools, farm equipment, or any of the hundreds of items covered by the broad terms of capital assets. Provision of the bill would apply to some 6 million farmers and to 4 million small and large businesses.

"Thus," explained Senator Capehart, "when we pass this bill we will be making it possible for these 10 million business units to put more people to work almost at once. It is true that this bill would have the effect of postponing some tax revenues. But at the same time, it is probable that the end result of stepped-up capital investment would, over the long pull, create even greater tax revenues in the future."

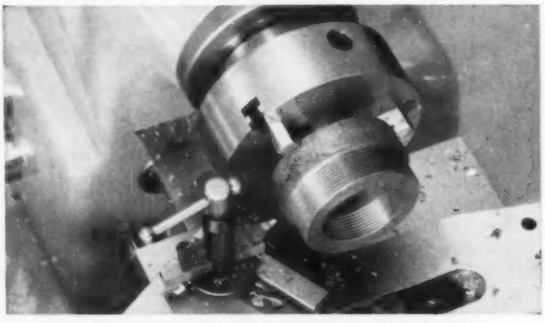
HARDINGE
ELMIRA, N.Y.

# "The Outstanding Tool Room Lathe"



Precision Collet work for all sizes to 1 – 1/16" Collet seats *directly* in spindle.

Precision Step Chucks for diameters up to 6". Provides Collet-like accuracy.



Integral Mount Jaw Chucks for precision holding of regular or irregular shapes up to 5".

**Hardinge Model HLV 10" Lathe** was primarily designed to fill a very old existent gap between the plain precision bench lathe and the heavy duty engine lathe.
Extreme accuracy, high spindle speeds, and thread cutting ability are coupled with power and ease of operation to obtain the desired results rapidly.

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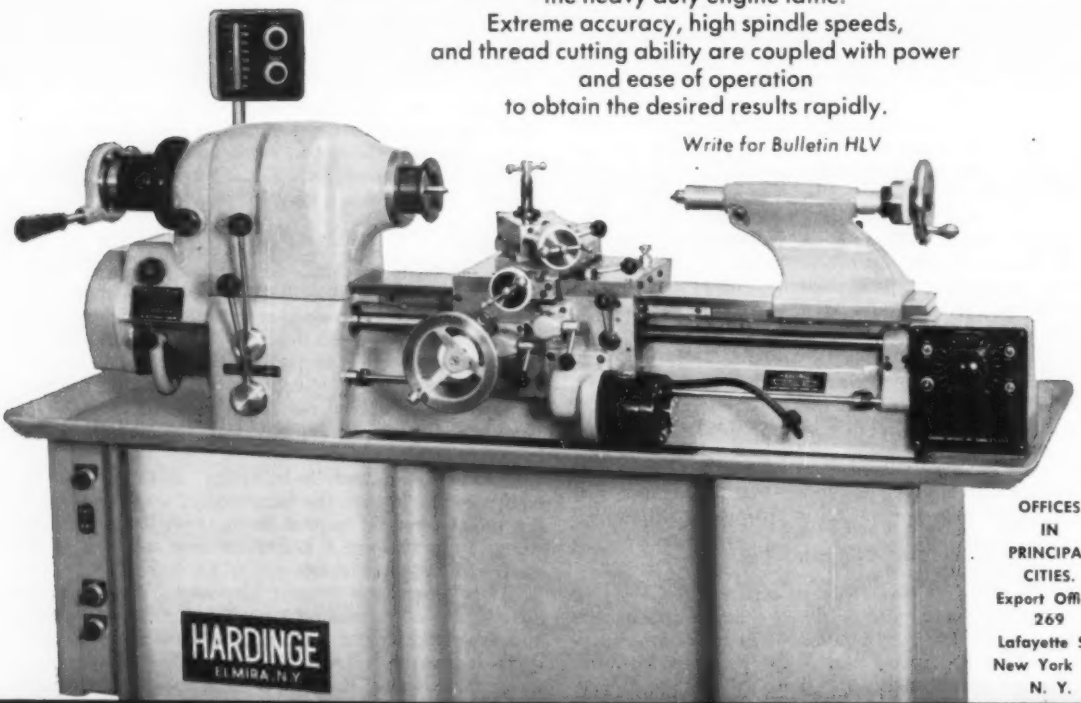


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**Machinery**
JULY 1958

# *If It Flies, It's Obsolete!*

INDUSTRIAL PROGRESS, according to the philosophy of American businessmen, comes at least partially from constant improvement of the product. Automobile manufacturers, for example, are always working on next year's models or those of the next several years, while busily engaged in turning out current designs.

In the aircraft industry this problem of management is even more acute because of the length of time that it takes to develop a plane on the drawing-board and then to get it into production. When a new type of plane is ready to fly, it is obsolete in terms of the aircraft already conceived by the aerodynamic engineers and other scientific minds.

Defense considerations have made this situation a matter of prime necessity for the nation's security and welfare. However, these conditions have been of inestimable influence in the phenomenal development of today's aircraft and guided missiles. Think of the tremendous advances in aircraft speed during only the last decade. They seem fantastic when one recalls that the first airplane for which the Government contracted was to have a guaranteed speed of a mere 40 miles per hour. That was less than fifty years ago —only a moment in terms of man's existence on this planet.

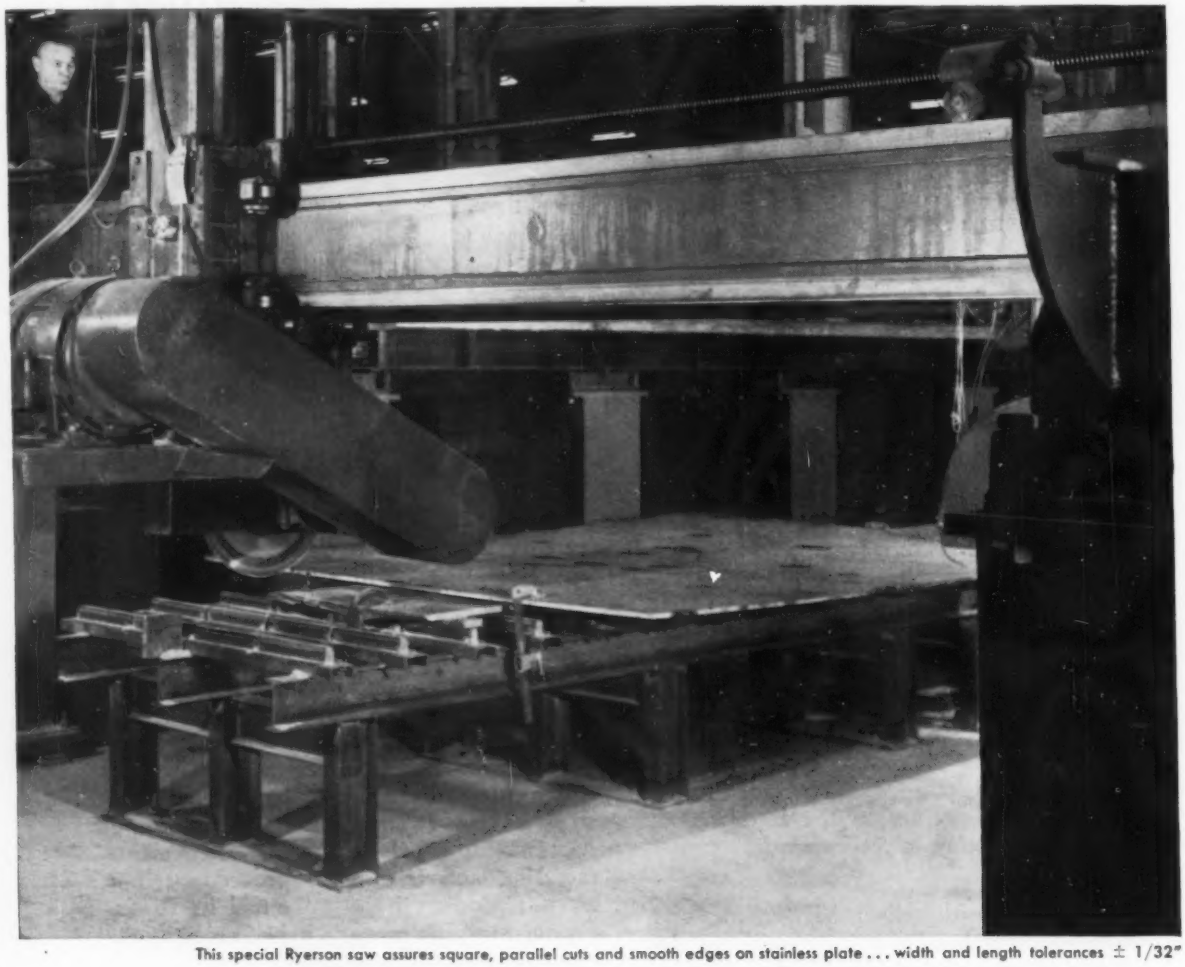
Today, fighter aircraft exceed the speed of sound. Commercial transport planes are being built that will fly 10 miles a minute. Satellites hurtle through space at 18,000 miles an hour.

Behind the speeds of these various types of aircraft lie the production techniques that have made them possible. New metals had to be produced to withstand the high heat developed by the potent propellent fuels and the friction resulting from the passage of metal structures through air at great speed. Lightness of weight has been increasingly important as planes have increased in size, and this has led to the use of honeycomb-metal structures for strengthening various components. All of this has resulted in new manufacturing and fabricating procedures. The aircraft industry has always had its special production problems and has of necessity developed special techniques.

This—MACHINERY's Eighteenth Annual Aircraft Production Number, now including guided missiles—brings our readers up to date on manufacturing processes that are meeting today's needs of the aircraft industry. Manufacture within millionths of an inch, the expanding use of tape-controlled machine tools, and novel methods of machining honeycomb cores, are but three of the subjects covered in this special issue.

Charles O. Herb

EDITOR



This special Ryerson saw assures square, parallel cuts and smooth edges on stainless plate . . . width and length tolerances ± 1/32"

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**WIDEST SELECTION**—No other source comes close to offering a comparable range of stainless types, shapes and sizes—so you can always get exactly what you need.

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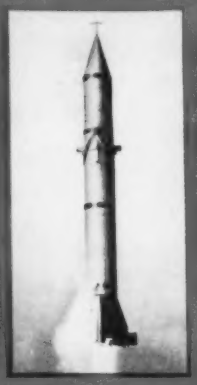


# MACHINERY'S 18th

## Aircraft and Missile Production Number

July 1958

Photos courtesy
Chrysler Corporation

Fig. 1. Latest type of Onsrud spar mill in action, removing 1390 pounds of chips from an aluminum-alloy lower-keel longeron that weighs 1700 pounds in the extruded form.

# CONVAIR MODERN METHODS

CHARLES O. HERB
Editor

A NEW ERA in American commercial flying is on the horizon, now that several companies are building huge jet-propelled planes for the airlines. Among these concerns, the Convair plant of the General Dynamics Corporation, San Diego, Calif., has expended $22,000,000 for tooling and other facilities in preparation for building the Convair "880." Almost $4,000,000 has been spent for machine tools and accessory equipment alone, and more expenditures for this type of machinery are anticipated.

The Convair 880 is designed to bring jet-age travel to medium-sized cities, and is suitable for use with existing runways and terminals. It will operate profitably at ranges of 300 to 3000 miles and will deliver passengers to their destinations at speeds in excess of 10 miles a minute. Eighty-eight passengers can be accommodated in the de luxe-interior planes and 109 passengers in the coach version. The plane is intended for altitudes up to 40,000 feet and will have a maximum take-off weight of 178,500 pounds, or almost 90 tons. Planes of this type will be flown on major airlines by the spring of 1960.

Over 1,000,000 square feet of factory area have been made ready for the 880 production and most of the new manufacturing equipment has been installed. Machine tools especially designed to facilitate economical production of the 26,000 different structural parts (exclusive of systems) required for each plane are an out-

# AS THEIR JET TRANSPORTS

standing feature of the production lines. As far as possible, the new machine tools are automatically operated through the use of tape and electronic controls.

One of the most spectacular machines is the duplex-carriage, 105-foot-long Onsrud spar mill shown close-up in Fig. 1 and almost full-length in Fig. 2. It is the industry's first spar mill employing electro-hydraulic controls for a superior finish, and high speeds and accuracy. In these illustrations the machine is seen finishing the lower-keel longeron for the 880 plane, which weighs 1700 pounds in the extruded form and only 310 pounds when finished. In other words, the spar mill removes 1390 pounds of aluminum alloy in the form of chips. Modifications in the extrusion for later lots will result in a reduction to 1200 pounds before milling.

Cross-sections of this keel have an infinite number of configurations so that it is necessary to impart up-and-down and angular movements of the cutter-heads almost constantly as each milling head carriage moves along the bed. One carriage is equipped with two milling heads, one horizontal and the other vertical. The second carriage near the foreground in Fig. 2 has four horizontal milling heads. The milling head seen in Fig. 1 is approximately horizontal, while in Fig. 3, it is tilted to a considerable angle. Milling cutters up to 16 inches in diameter and up to 18 inches wide can be employed.

Selsyn tracer controls supplied by the General Electric Co. effect the varying movements of the milling cutters as either carriage travels along the bed. The cam followers on the tracer units run on cams mounted along the front of the bed as seen in Fig. 4. Rises and falls on these cams cause similar movements of the followers, and these, through an electro-hydraulic control system, impart movements to the milling heads as

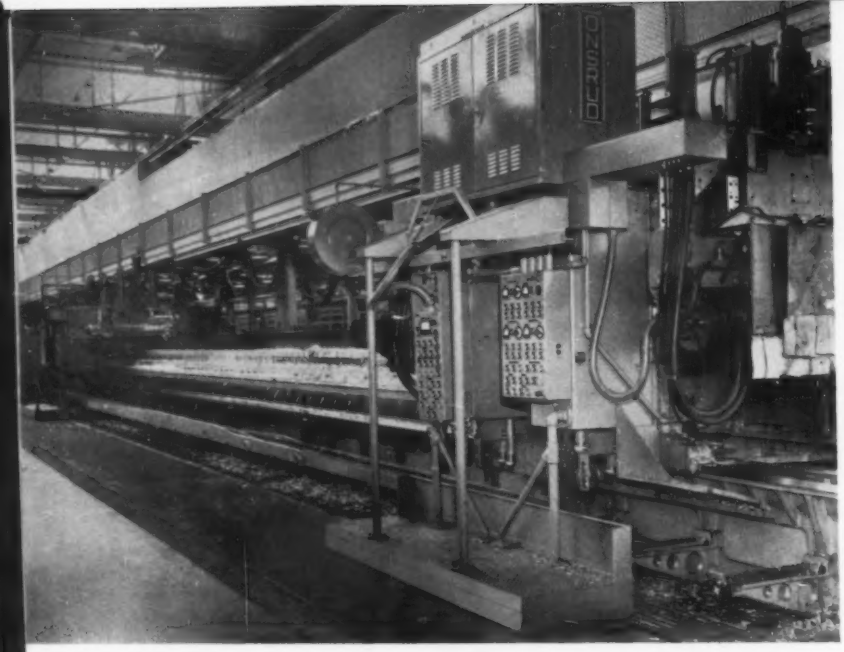


Fig. 2. Spar mill 105 feet long, which is provided with two milling-head carriages, one of which carries two cutter-heads and the other, four.

required by the varying configurations of the work. Torque motors provide power for these movements of the heads. Speeds of 1800 and 3600 rpm are available for the horizontal heads and 3600 and 7200 rpm, for the vertical head. The heads are driven by 100-hp motors. Parts up to 60 feet long by 36 inches wide can be handled with this equipment. A conveyor carries away the rapidly accumulating chips.

Numerical control is considered by Convair production personnel to be the greatest single development in the history of machine tools so far as the aircraft industry is concerned. Their experience led to the installation of the big Giddings & Lewis skin miller shown in Fig. 5, which is completely controlled by a magnetic tape. The vertical and horizontal heads are operated in these planes and at prescribed angles by a Numericord control system.

This system is capable of operating the machine with two heads, in five continuous axes of motion, in addition to performing twelve switching and auxiliary functions. The control cabinet seen at the extreme right in Fig. 5 is provided with visible horsepower-consumption meters, rate-of-feed indicators, and manual controls for setting-up purposes or for operating the machine when a tape is not being used.

A typical application of the vertical head is shown in Fig. 6, and of the horizontal head, in Fig. 7. The bed of the machine will accommodate work up to 30 feet long by 10 feet wide, which is sufficient capacity for the huge swept wings of the 880 plane. The milling heads deliver 50 hp at 1800 rpm, and 100 hp at 3600 rpm. Mist lubrication is supplied to the milling cutters during the operation.

Another numerically controlled machine tool

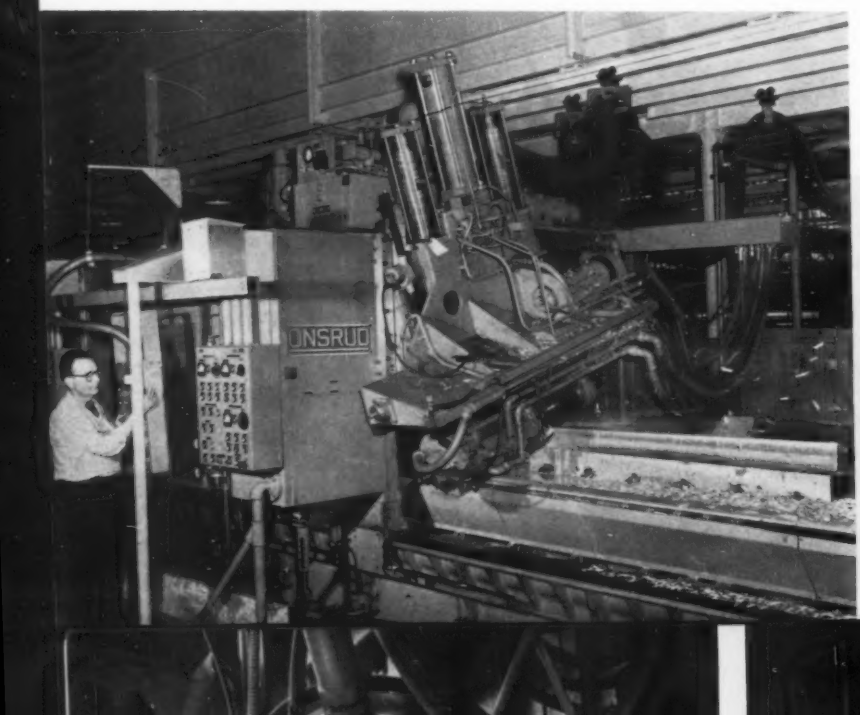
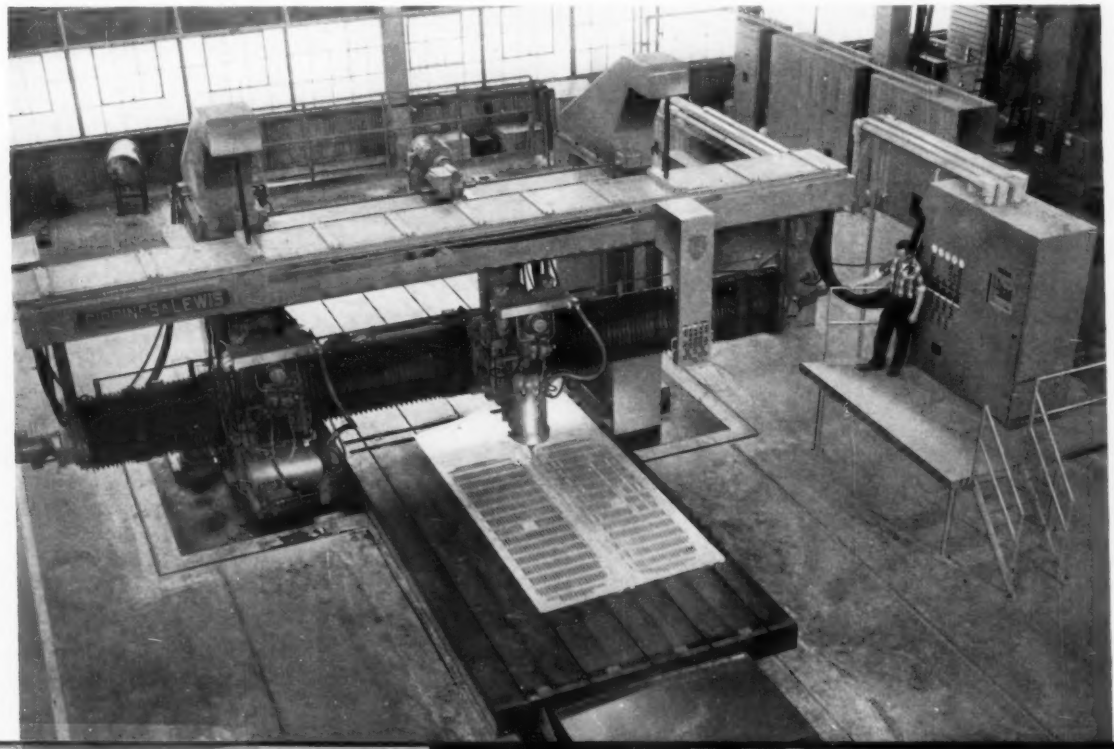


Fig. 3. Horizontal heads on the spar mill can be tilted as much as 45 degrees either side of the vertical center.

Fig. 4. (Right) Up-and-down movements of all cutter-heads and sideways and tilting movements are derived from long cam-plates mounted at the front of the bed.

Fig. 5. (Below) Huge Giddings & Lewis skin miller which is completely controlled by magnetic tapes placed in the Numericord cabinet at right.

is the Giddings & Lewis Variax profiling machine illustrated in Figs. 8 and 11. Any part up to 168 inches long by 48 inches wide can be milled automatically along three axes without the necessity of using templates to guide the cutter along and over the changing contour of the work. A Numericord unit provides fourteen channels of instruction. It is capable of operating the cutter-head in three axes of motion and in addition perform twelve switching and auxiliary functions. Once the milling head has been lined up manually, all the operator need do is press a button to start the machine on its complete cycle. Operations that formerly took ten hours are now performed in seventy minutes with this numerically controlled equipment.



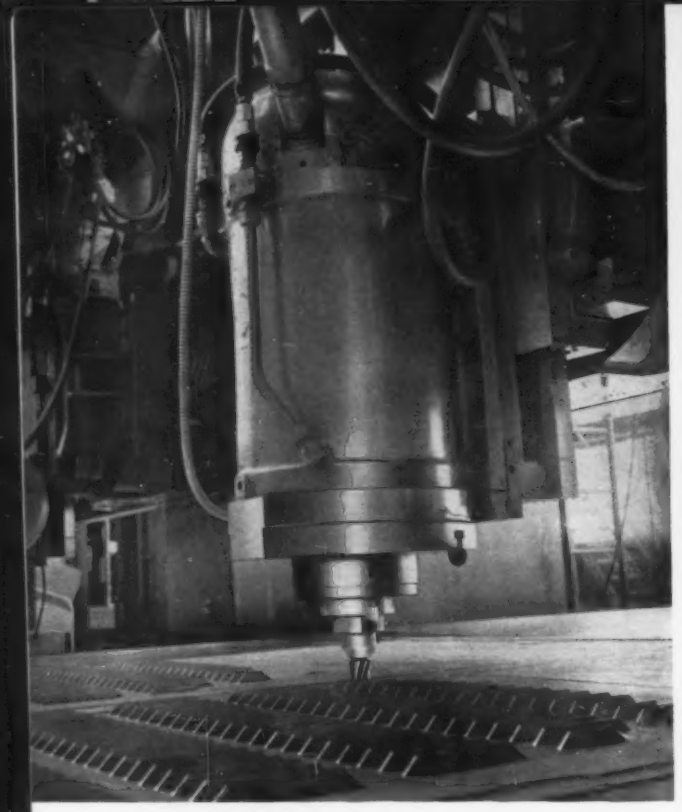


Fig. 6. Close-up view of the vertical milling head on the skin miller in Fig. 5 showing a cut being taken across the end of integral ribs.

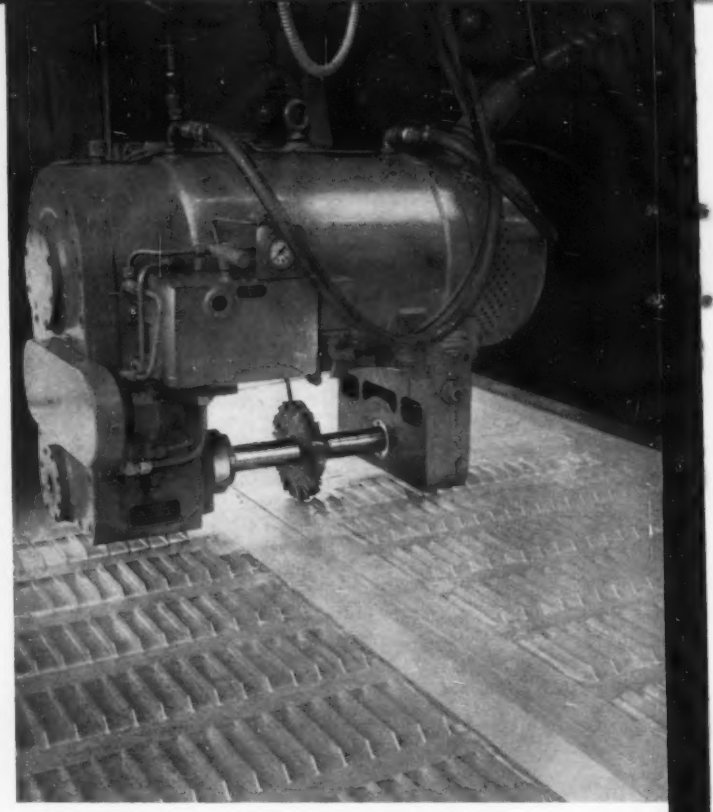


Fig. 7. Typical operation on horizontal milling head of the skin miller on a panel having series of integral ribs that were machined from solid.

An exceptionally versatile profiler that is widely employed at Convair for both heavy and light work is the Sundstrand machine in Fig. 9. Cuts are controlled in two planes by moving the stylus of a True-Trace hydraulic head along a template mounted at the front of the table. There is also a hydraulic valve on the column of the machine for quickly changing the height of the cutter with respect to the work for taking cuts at different levels. This valve avoids the necessity of using a stepped template. A small turret with a series of micrometer stops graduated to 0.001 inch facilitates setting the cutter to different heights.

Cuts as deep as 2 inches have been taken on this machine with a cutter 1 1/4 inches in diameter at full speed and feed. Speeds from 52 to 1990 rpm are available. The rate of feed is gov-

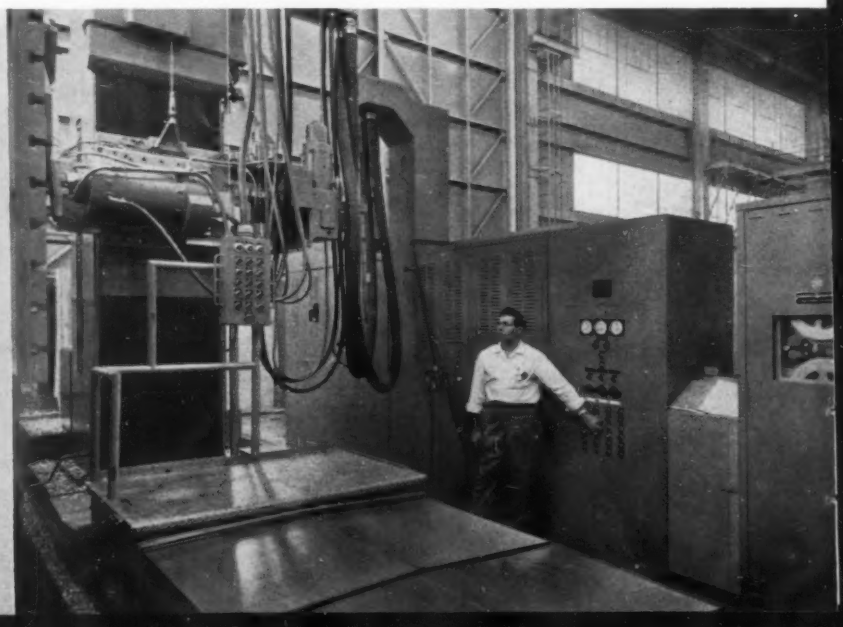


Fig. 8. Huge Giddings & Lewis profile-milling machine which will produce desired configurations through the use of a magnetic tape, thus eliminating the need for templates.

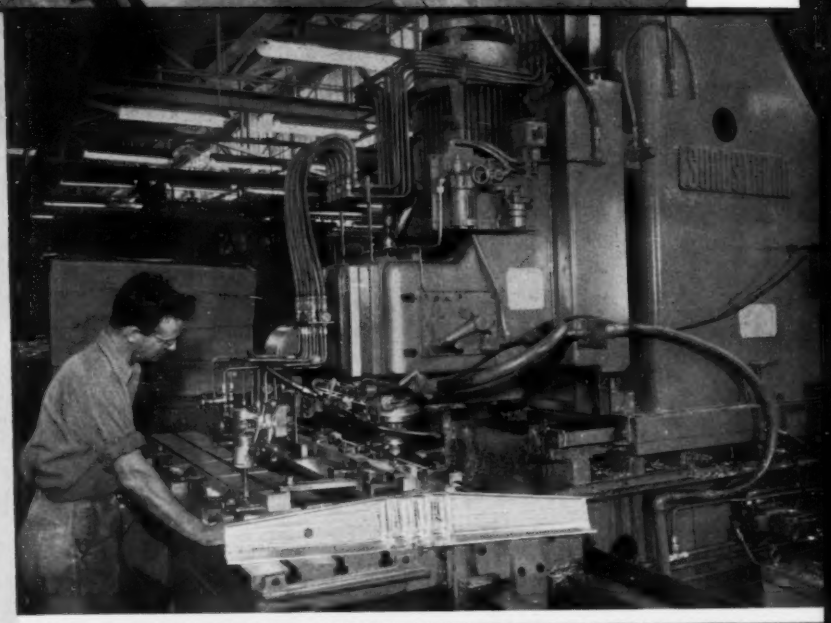


Fig. 9. Versatile Sundstrand profiling machine which is applied to a wide range of light and heavy work, both prototype and production.

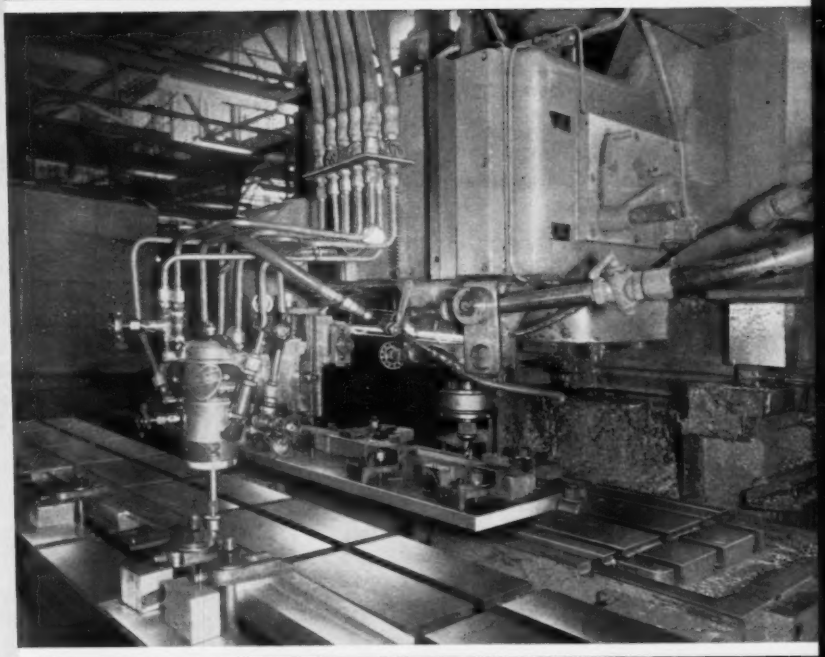
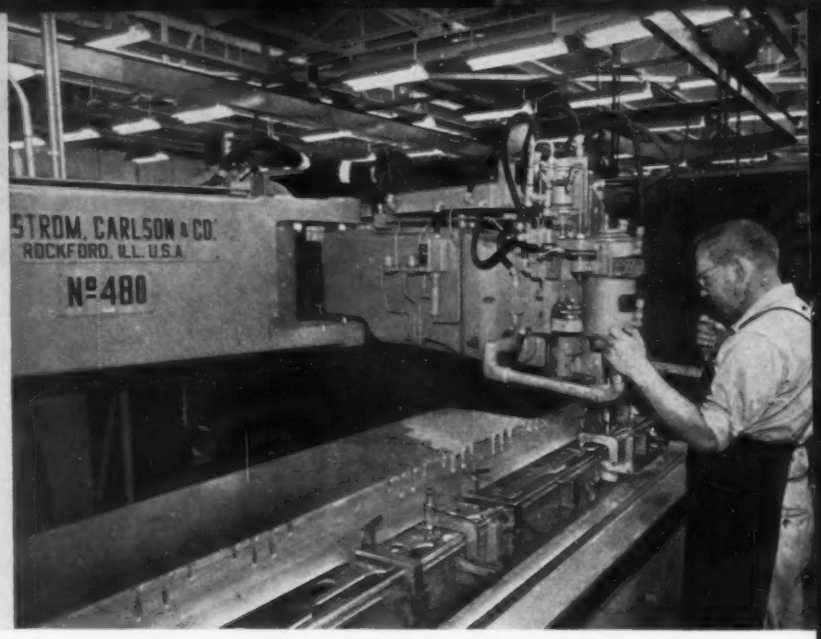


Fig. 10. Close-up view of a typical operation being performed on the profiling machine in Fig. 9, which is controlled by a True-Trace hydraulic device at the front of the table.

Fig. 11. Typical operation being performed on the magnetic tape-controlled machine in Fig. 8. Note the absence of a template.

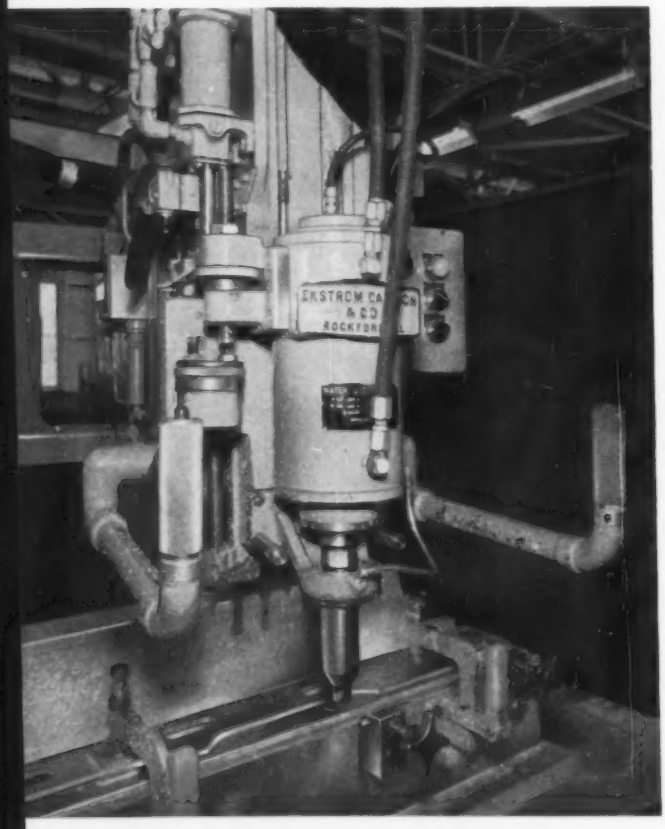
Fig. 12. (Right) Modern routing machine being used for producing elongated holes, contoured edges, and notched slots on a structural member for the Convair 880.

Fig. 13. (Below) Close-up view of the routing head on the machine in Fig. 12 showing how the cutter-spindle is guided along a template by the operator.




erned by the manual manipulation of the tracer stylus. Standard end- and face-milling cutters are used. Fig. 10 shows a close-up view of a typical job being performed on the machine.

Routing has been substituted for profile milling on certain light-section structures as, for example, work of the type seen on the Ekstrom-Carlson machine in Figs. 12 and 13. In the operation shown, the router was used for cutting elongated holes in one leg of a structural part and for profiling along the edge of this leg. Notches of different depths were also routed in the leg that is seen upright in the picture. The notches were, of course, cut with that leg of the structural member mounted horizontally on the table of the machine. Templates overlaid on the work guide the cutter and prevent mistakes.



This machine is equipped with a water-cooled motor that provides speeds of 7200 and 14,400 rpm. Depth stops on the side of the head control down movements. Special fixtures are provided for each job. Clamps attached to the front of the table grip the work from front to back and also downward. A wing-bulkhead rail was being routed when the photographs were taken. Other typical work handled by this machine are light spars and stiffeners.

The Arrow profiling machine in Fig. 14 is equipped with a cutter-head that can swivel 20 degrees either side of the vertical center line. Thus "twists" can be machined longitudinally in swarfing and other operations. Straight movements of the cutter-head up and down and crosswise are controlled by the True-Trace hydraulic head seen in Fig. 14 being guided by the operator along a template. Pivoting movements of the cutter-head are effected through the use of a second tracing valve unit with rollers, which is seen adjacent to the cutter-head. Spindle speeds from 37 to 3000 rpm are available.

The large fuselage belt frames required for the 880 jet transport planes necessitated the installation of the 75-ton Cyril Bath radial drawformer shown in Fig. 15, which is believed to be the biggest machine of this type in the world. Various other parts made from extrusions are, of course, handled on the same machine. The illus-

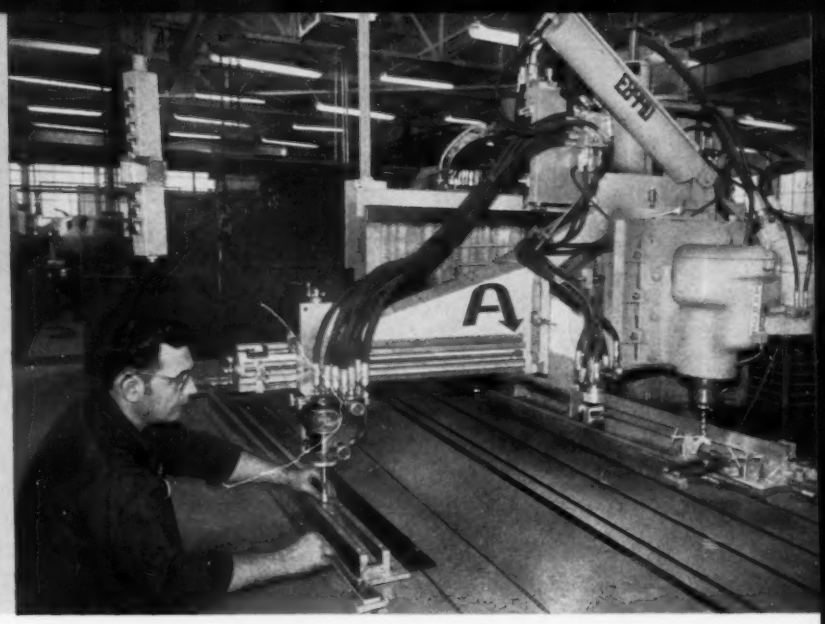


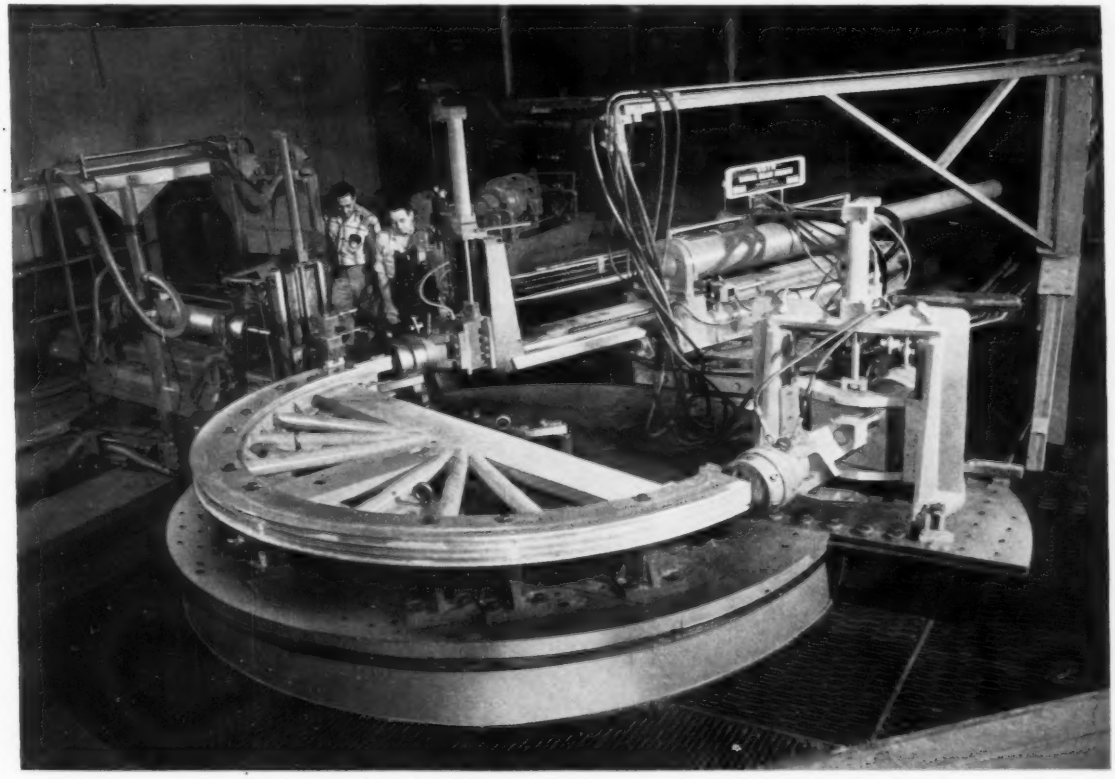
Fig. 14. (Right) Profiling machine on which the cutter-head can be swiveled for the taking of swarfing cuts. The cutter-head can, of course, also be moved vertically and horizontally.

Fig. 15. (Below) Cyril Bath radial draw-former of 75-ton capacity which is used for producing large fuselage belt frames and a great variety of other parts.

tration shows an aluminum H-section that measures 3 1/16 by 4 7/8 inches and has cross-sectional thicknesses up to 3/8 inch being stretch-formed to an outside radius of almost 6 feet.

One of the special features of this machine is a yield and tension control. Signals imparted by a load cell on one pull head are transmitted to an amplifier which gives readings for yield, tension, and elongation. After one piece has been formed to specifications, settings made on the instrument panel will insure the production of subsequent pieces with the same characteristics.

This radial draw-former is also used for ironing T-sections to required contours, such an operation being shown in Fig. 16. The work is mounted on a form block of required outline and the traverse slide is moved lengthwise of the work, the slide being fitted with a suitable block for pressing the part against the form-block. In



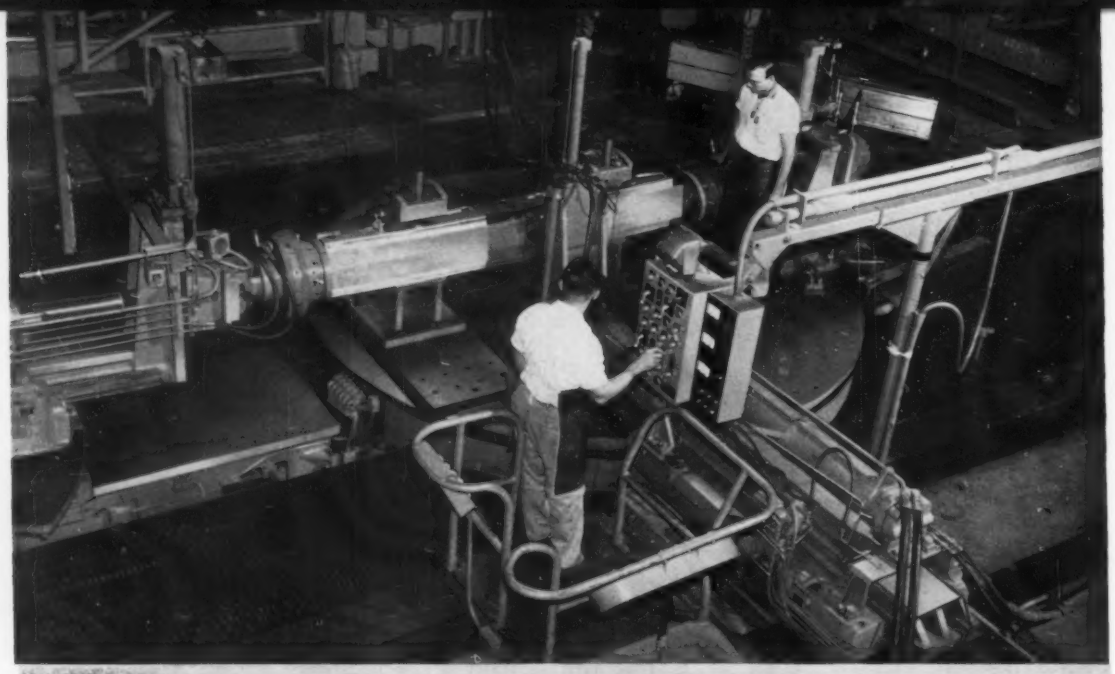


Fig. 16. An application of the huge radial draw-former in which an aluminum-alloy T-shaped extrusion is being ironed to a necessary contour after it has been heat-treated.

Fig. 17. Oven used for the heat-treatment of aluminum structural members prior to radial draw-forming or ironing. This oven is believed to be the largest in the aircraft industry.

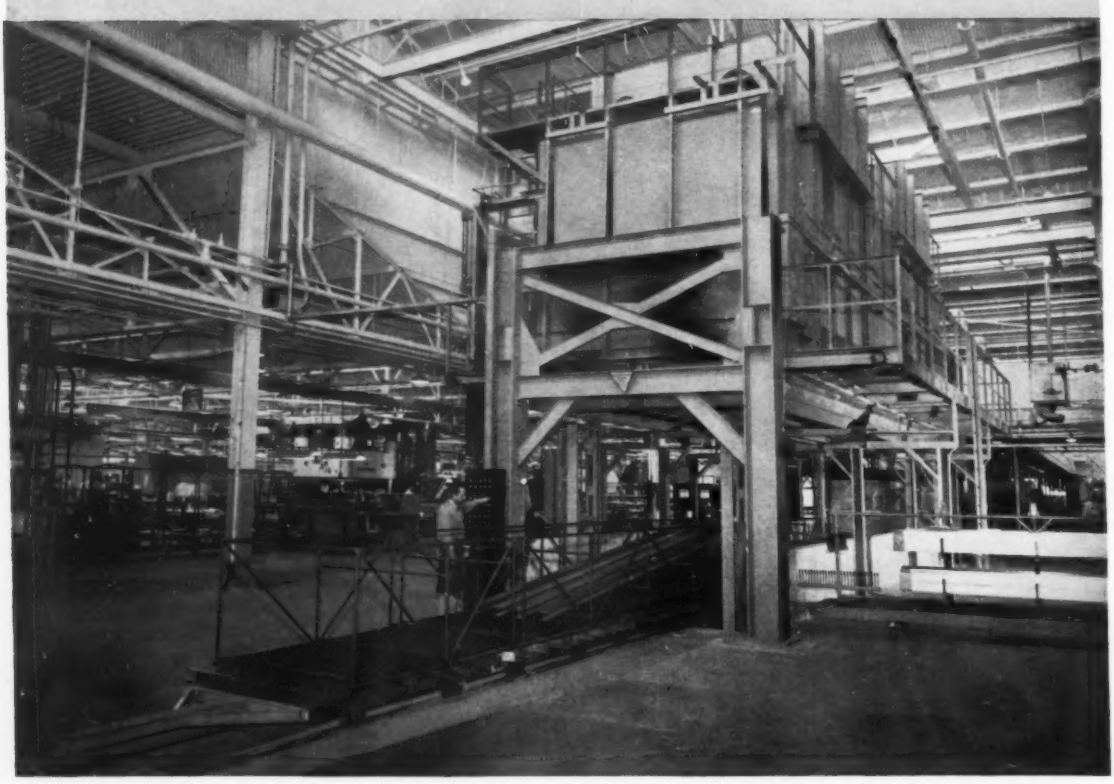


Fig. 18. View of the quench tank in a pit directly beneath the huge oven shown in Fig. 17, into which work is dropped from the oven within ten seconds.

all operations the machine is hydraulically operated under electrical control.

Before parts are sent to the radial draw-former, they are heat-treated in the Despatch oven shown in Fig. 17. However, before they go to this oven they are thoroughly cleansed with Oakite in tanks. Unless oil, dirt, or grease is removed from the work-pieces before heat-treatment, they will have a spotted appearance. The oven has a usable interior area 41 feet long by 8 feet wide by 8 feet high, and is believed to be the largest of its type in use in the aircraft industry.

The oven is electrically heated and can be maintained at temperatures ranging from 400 to 1300 degrees F. In conditioning the aluminum-alloy structures for the 880 transport, temperatures ranging from 860 to 920 degrees F. are ordinarily employed. From thirty to sixty minutes are required to bring parts up to the desired temperature. They are then soaked in the heat for one hour.

For the heat-treatment, the work is loaded on the structural-steel rack or car seen in Fig. 17. Then the car is pushed into the space beneath the oven and lifted by a hydraulic elevator into the oven tower. At the end of the heat-treating period the car with its load of work is quickly lowered into a quenching tank in a pit directly below the furnace, as shown in Fig. 18. From the time that the oven doors are opened and the work is completely immersed, not more than ten seconds must elapse. The actual operation has been accomplished in six and one-half seconds. The water quench is held at a temperature of 65 degrees F. Parts are held in the quench for approximately one minute.

It is imperative to prevent aluminum sections and sheets from aging between the heat-treating and drawing operations. Hence, a huge refrigerator over 40 feet long has been installed in the plant. The work-pieces are stored in this refrigerator as soon as they come from the quenching step. The refrigerator is maintained at a temperature of minus 20 degrees F. The method of storing parts along the walls of this freezer is illustrated in Fig. 19.

Fig. 19. To prevent aluminum structures from aging during the time elapsing between heat-treating and draw-forming, parts are stored in a big refrigerator that is maintained at a temperature of minus 20 degrees F.

PHENOMENAL becomes a rather prosaic term when used with reference to the many electromechanical devices conceived in recent years to do the work previously performed by human muscle and brain. Such devices will automatically take an interceptor airplane off the ground, direct it on its course, climb it to the desired altitude, fly it toward an enemy aircraft, make it change direction as the enemy tries to get away, and fire its gun at the instant that conditions are right for a direct hit.

Electromechanical devices also direct missiles on their intercontinental flights; prevent supersonic aircraft from pitching or yawing; and furnish a means of automatic armament control. In the form of digital computers they provide for the almost instantaneous solution of complicated mathematical problems; control of manufacturing methods and production quantities; analysis of various shop problems; and data processing. In the form of numerical controls, they govern the operation of machine tools and other machinery.

All of these electromechanical devices and a considerable variety of others are everyday products of Autonetics, a division of North American Aviation, Inc. In its Downey, Calif., plant there are approximately 2000 engineers constantly engaged in about seventy-five different projects and studies. There are more than 2100 persons employed in the manufacturing divisions of its several plants. This article will describe some of the most interesting operations in the Compton, Calif., plant where some parts must be produced regularly within an accuracy of 12 millionths of an inch.

This is the case in producing optical lead-screws for navigation systems. These screws are made with a 52-degree thread angle and forty threads per inch. The threads are undercut at the root 0.004 inch wide by 0.006 inch deep to facilitate lapping of the threads in the final manufacturing stages of the lead-screw. The total error in the 7 inches of thread length must not exceed 12 millionths of an inch, and the same limit is specified for "drunkenness," or straightness of the thread. The lead-screws have a nominal diameter of 1/2 inch and are made of SAE 1113 steel.

Preliminary operations consist of accurately centering the lead-screw blank and then drilling and boring both ends to receive inserts for piloting centers. Several diameters are then turned and ground on the two ends of the blank, and the long surface to be threaded is ground, after which the threads are rough-ground from the solid on a Reishauer machine. The threads are

# LABORATORY PRECISION

## for Electromechanical Devices

**Fine-pitch optical lead-screws for navigation systems, for example, are produced in quantities accurate within 12 millionths of an inch in North American Aviation's Autonetics Division—the profile of involute cams must be true within 6 millionths of an inch.**

CHARLES O. HERB
Editor

ground to size within 40 micro-inches, so far as the lead and drunkenness are concerned, over the entire length. A close-up view of this operation is shown in Fig. 1. The operator follows the progress of thread grinding by observing the operation through a high-powered magnifying glass. Undercutting of the threads also occurs in this step of the manufacture. The lead-screw is then laid on a bench for twenty-four hours to provide for the relief of strains.

The lead-screw is next thoroughly cleansed of any foreign matter by spraying on a cleaning solvent and then blowing off the solvent with compressed air. During this process, the operator wears rubber gloves. Next, the thread is checked for lead error, length of thread flank, root clearance, centrality of the root with the thread flanks, taper of the outside diameter with respect to the screw axis, and surface finish of the thread flanks. All of these inspections are made on the Sip measuring machine illustrated in Fig. 2.

In checking the threads for lead error, a goniometer microscope is placed in the machine head. After the lead-screw has been mounted between centers, this microscope is focussed on the fourth thread from the one end to obtain a zero location. The lead-screw is then moved in increments of 1.00000 inch over the entire length of the screw and recordings are made for each setting. This inspection is made twice to provide a double check for lead error. The thread-root clearance is checked for width and for its centrality with the thread form by observing the root over the full length of the lead-screw through the microscope. The other inspections performed in this machine are also carried out with the aid of the microscope.

After this inspection, the threads are finish-ground on the Reishauer machine and are again checked on the Sip machine. The same inspection procedure is followed as before. If there is an error of more than 40 micro-inches per inch of length anywhere along the screw, it is returned to the grinding machine for correction. When the screw is correct, it is returned to the temperature-controlled room for close grinding operations on the end diameters, and for thread lapping. During the cylindrical grinding operations, the threaded portion of the screw is protected by first wrapping it with protective tape. Before lapping, the tape is, of course, removed and the entire screw is again cleansed of all foreign matter.

In lapping, use is made of the simple vertical machine illustrated in Fig. 3, which provides a means of rotating the screw at a speed of 65 rpm. Split brass bushings are first pressed into two

Fig. 1. (Left) Grinding the threads of a fine-pitch lead-screw for a navigation system that must be accurate and straight within 12 millionths of an inch of total error in 7 inches.

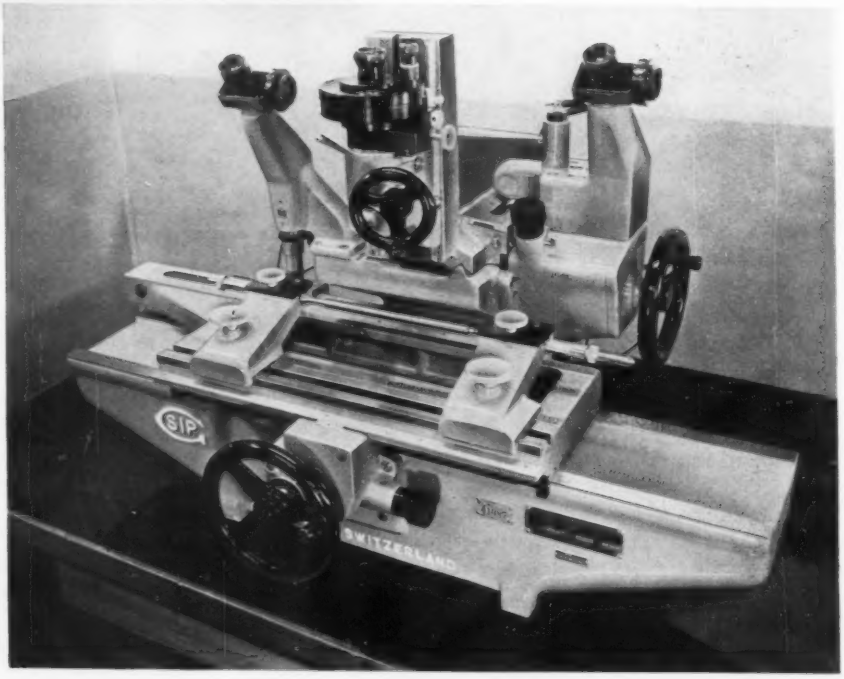



Fig. 2. (Right) After thread has been rough-ground and, also, after finish-grinding, the lead-screw is checked on this machine for various characteristics.

ends of the lead-screw to insure accurate support of the lead-screw on centers.

With the lead-screw mounted on the machine as shown, a small quantity of lapping compound is brushed on the threads; then both halves of a lapping nut are assembled on the screw as shown in Fig. 4. Adjusting rings at the top and bottom of the lapping nuts provide for altering the pressure on the threads so as to insure free running of the lapping nuts on the screw. The lapping nuts are made of 1/2-hard brass and are, of course, provided with threads to suit those of the lead-screw. Counterbalancing weights attached to the nuts insure a delicate feel in lapping.

Lapping is a long procedure. Two sets of lapping nuts are used in various combinations to obtain twenty-four different settings of the laps. The lead-screw is lapped one-half hour with each combination so that it takes twelve hours to lap one screw. In this operation, the drive to the work-spindle is automatically reversed each time the lapping nuts reach the top and bottom of the screw.

At the end of this lapping process, the lead-screw is again cleaned, after which a checking nut is screwed on the threads. This nut is adjusted to run freely over the entire length of the screw and is manipulated up and down until a smooth-

running condition is obtained. The lead-screw is then again removed from the machine, thoroughly cleaned, and wrapped in tissue paper until it can be checked on the auto-collimator and accessory equipment shown in Fig. 5. The lead-screw, checking nut, and a mirror are placed in a holding fixture in approximate alignment with the auto-collimator. The latter is then adjusted so that a light beam is balanced through the amplifier. Readings are then taken on an Esterline-Angus recorder. These readings must not exceed twelve vertical lines over the full length of the screw. The space between each vertical line represents one millionth of an inch.

Another operation that calls for even greater accuracy consists of grinding involute cams of the type seen lying at the front of the machine base in Fig. 6. The actual tolerance on the profile of this cam is only 6 millionths of an inch, while the allowable involute error is 12 millionths. Any errors are reduced even further because of the close base circle and normalcy tolerances: Cam surfaces must have a finish of 2 rms.

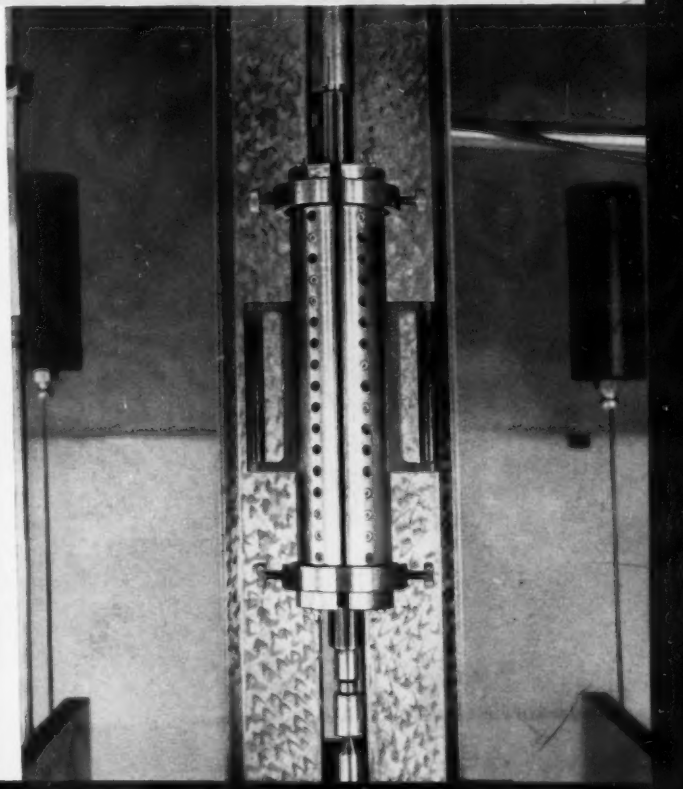
The involute cam is mounted on a shaft which is provided with two base-circle rolls, one at the front and one at the back of the equipment, which run back and forth on flat horizontal bars. The bars and rolls are accurate within 4 millionths of an inch as to profile. The diameter of the rolls must be to size within 0.0002 inch and true within 0.00001 inch. The rolls and the cam are run back and forth on the bars throughout the operation under the control of a small variable-speed servomotor at the right-hand end of the base. The large cylindrical member on the roll shaft is connected to a counterweight through an overhead wire to insure uniform movement.

At the beginning of the operation, toolmaker's buttons on the two rolls are advanced against dial indicators at the right. By bringing the buttons against these indicators at any time during the grinding process, the operator can determine whether or not the involute plane has remained the same. Grinding is performed by the face of a 1 1/2-inch diameter wheel on the spindle of an air-driven head at the front of the equipment. This spindle runs at a speed of 16,000 rpm. A micrometer provides for close adjustment of the wheel with respect to the work. The work is moved across the face of the grinding wheel at a rate of 20 feet per minute. There is a wheel-truing device at the front of the machine.

At the end of the operation the involute cam is also checked on the auto-collimator. Cam pro-

**Fig. 3. Extreme accuracy of the lead-screw is attained by a lapping operation which requires twelve hours of very careful lap manipulation.**

**Fig. 4. Close-up view of adjustable lapping nuts used in twenty-four combinations to bring the lead-screw thread to its high degree of accuracy.**



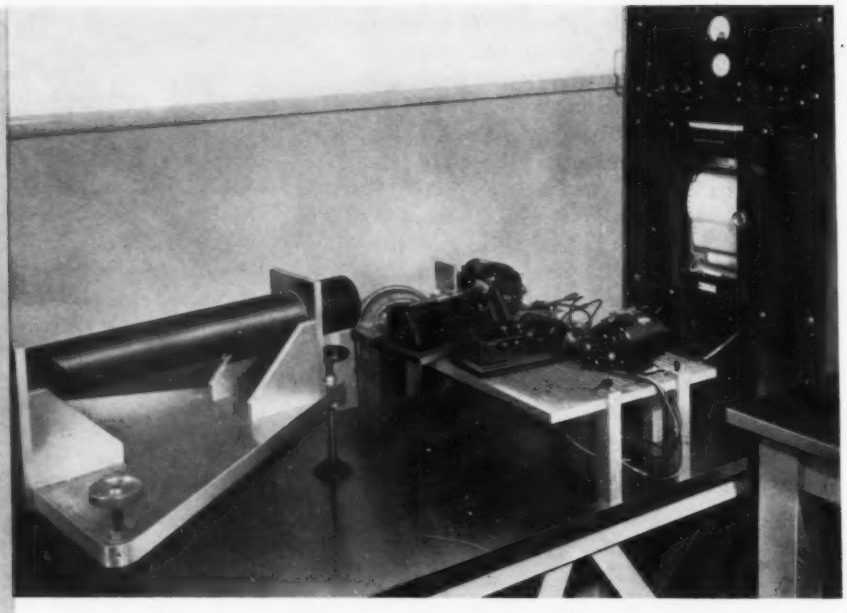


Fig. 5. Auto-collimator used in final inspection of the lead-screw to make certain that it has been produced to high degree of accuracy required.

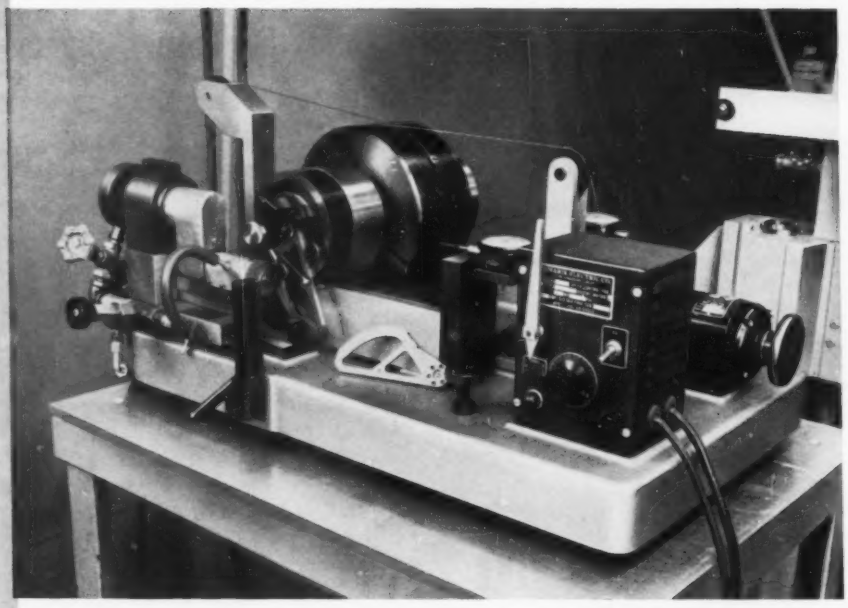


Fig. 6. Involute cams such as seen on the machine base are produced within an accuracy of 6 millionths of an inch so far as the profile is concerned and within 12 millionths with regard to involute error.

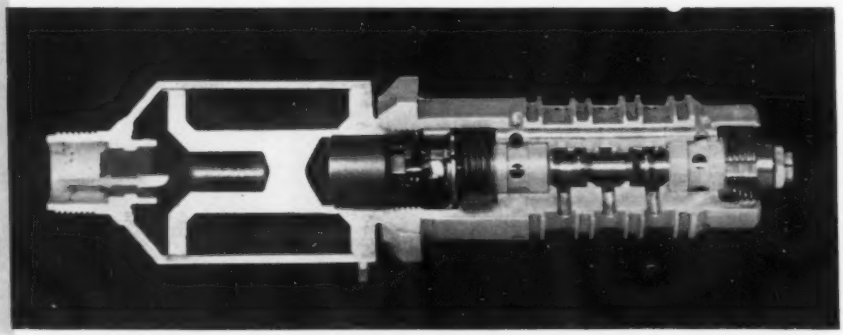


Fig. 7. Four-way solenoid-operated valve which is typical of precision work necessary on a large variety of parts required for electro-mechanical devices.

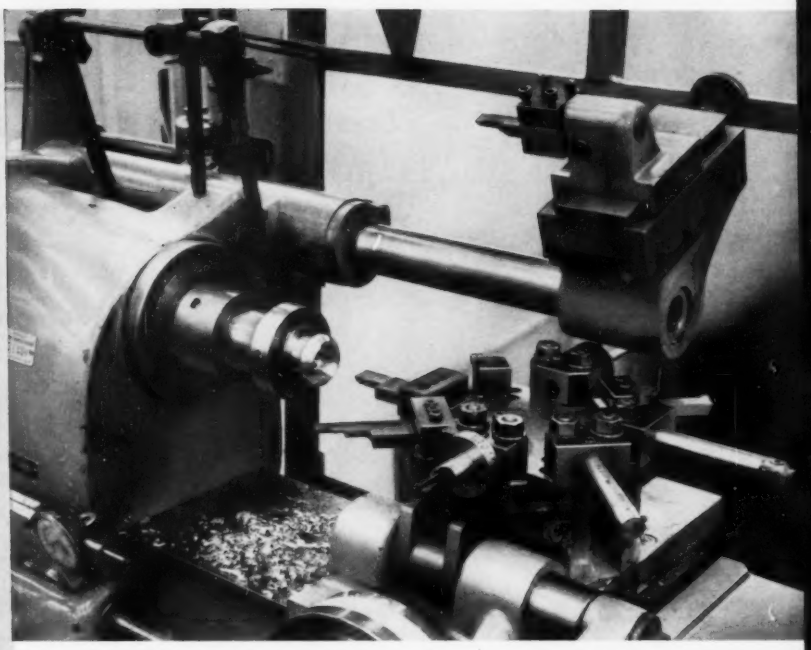


Fig. 8. Machining a four-way solenoid-operated valve on a small chucking lathe provided with a flat turret.

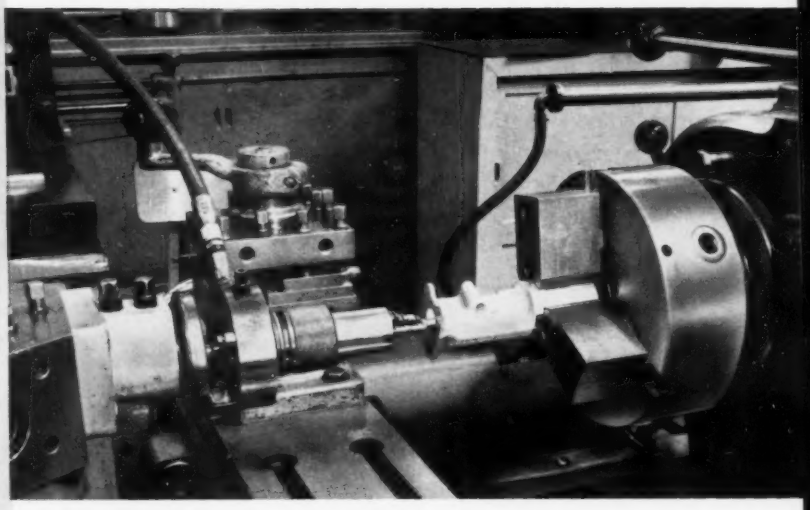


Fig. 9. Multiple-form cutter mounted on a turret lathe for simultaneously machining three internal grooves and adjoining beveled edges.

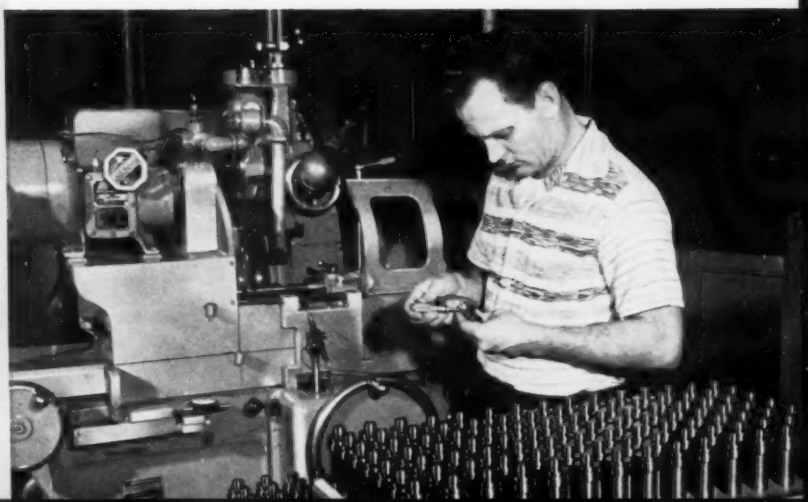


Fig. 10. Crushed-wheel grinding machine employed for the form-grinding of parts of many configurations on an economical basis.

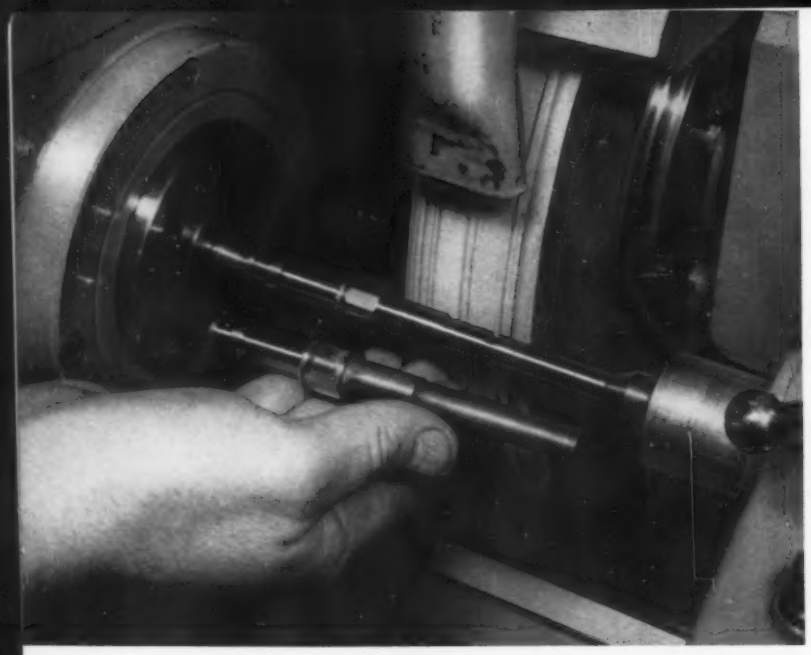


Fig. 11. Crushed-wheel grinding one end of a yaw damper shaft, the opposite end also being form-ground with a different wheel trued to the required shape.

files have actually been produced accurate within less than 4 millionths of an inch.

Laboratory accuracy is also specified for a wide variety of parts that are produced on standard machine tools. A typical assembly of such parts is the four-way solenoid-operated valve shown in Fig. 7. This valve is approximately 6 inches long. One of the parts has a series of lands that are contacted by seats on the valve stem. These lands are machined on the Hardinge chucking lathe in Fig. 8 which employs a multiple-form cutter similar to the one seen in line with the work in Fig. 9. The work on the Jones & Lamson turret lathe in this illustration is a pitch-damper housing in which three grooves and adjoining beveled edges are simultaneously machined by a carbide-tipped cutter. Coolant is supplied to the inside of the part at a pressure of 300 psi.

The pitch-damper housing on the machine in Fig. 9 has four bores ranging from 0.750 inch to 1.825 inches which are simultaneously produced with a stepped gun drill. Coolant at a pressure of 300 psi is also supplied during this drilling operation.

In the case of the four-way valve, there are four lands that must be machined to a specified width of 0.008 inch and to a finish of 32 rms. All of the internal cuts on this part are performed on

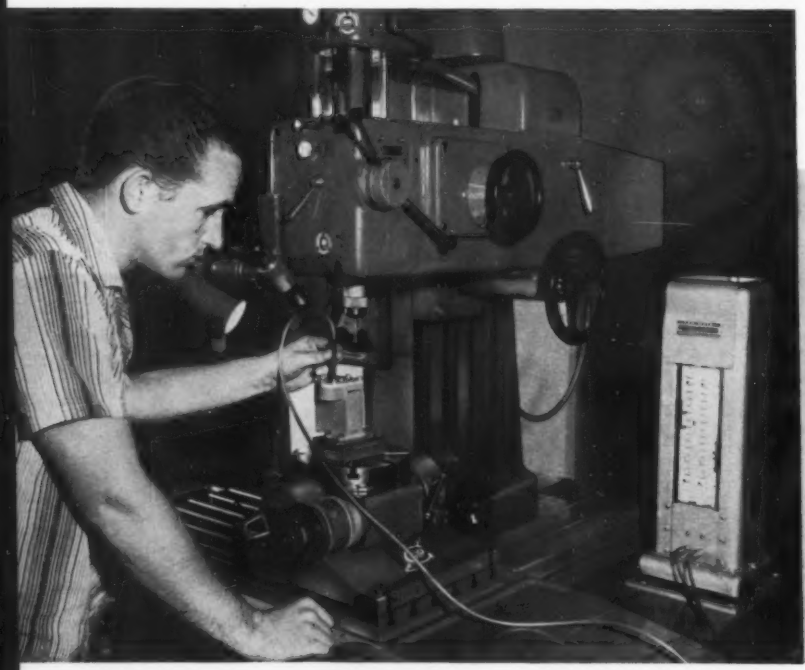


Fig. 12. Precise jig-boring operation performed with the aid of a high-powered magnification scale on a Precisionaire gage graduated to 0.000025 inch.

the Hardinge lathe, except the drilling of the original hole.

Crush form-grinding is performed on a wide variety of parts by the Sheffield machine shown in Fig. 10. The work-pieces illustrated are form-ground on one end by this machine. After substitution of a different wheel, they are simultaneously ground on a number of surfaces on the opposite end.

In the case of the work-piece seen in Fig. 11, which is a yaw damper shaft, seven different cylindrical surfaces, ten shoulders, and three bevels are simultaneously ground on one end. The time is eight and one-half minutes. Later, four cylindrical surfaces, four shoulders, and one bevel are ground on the opposite end in five minutes. Tolerances range from plus or minus 0.0005 inch to plus or minus 0.001 inch.

The Sip jig-boring machine in Fig. 12 is being used in the accurate drilling and boring of a small aluminum casting that serves as a servo gear-case. The tolerance is only plus 0.0002 inch minus 0.0000 inch on hole size and location. Accuracy of the hole is checked by means of a Sheffield Precisionaire gage.

Rocket fuel-pump blades, shown assembled and disassembled in Fig. 13, must be manufactured to close tolerances so far as both form and dimensions are concerned. In the illustration, the inspector is checking the interlocking form or "Christmas tree" end to make certain that it is in the proper plane.

Optical comparators are used extensively for checking the teeth of fine-pitch gears and other instrument components of irregular configuration. Fig. 14 shows a Kodak optical projector being used for the inspection of a gear of 96 diametral pitch. Gears with teeth as fine as 120 diametral pitch are used in the electromechanical devices produced in the plant.

**Fig. 13. One of several inspection steps followed to insure accuracy of rocket fuel-pump blades.**

**Fig. 14. Typical inspection carried out on optical projectors to observe profile of gear teeth and to measure irregular contours of a wide variety of other parts.**

MORE THAN 1300 stationary compressor vanes —and approximately the same number of rotating compressor blades—are required for each J-75 turbo-jet engine. The vanes vary from about 3 1/2 to 11 inches long, 1 to 3 inches wide, and 0.109 to 0.360 inch thick (through the airfoil section). They are made from AMS 5613 and 5616 stainless-steel precision forgings having a hardness of 35 to 45 Rockwell C.

Mass production of these precision components is done at the Thompson Products Jet Division in Cleveland, Ohio, making extensive use of contour-grinding techniques. Machining of the precision forged airfoil surfaces is not required, but exacting tolerances are specified for both the saddle (root) ends and the lug ends on the vanes. For example, parallelism of the lug ends with relation to the locating surfaces must be held to plus or minus 0.00075 inch, and the angular tolerance (twist) of the root ends is maintained within plus or minus 10 minutes.

The saddle end of each vane has two tangs, or ears, that vary from 0.062 to 0.072 inch thick. Thicknesses of the tangs is maintained within plus or minus 0.002 inch, and the spacing between them—which varies from 0.715 to 1.560 inches—is held to plus or minus 0.001 inch. These tangs are formed by grinding stock out of the solid forging—amounting to a removal of 0.350 cubic inches of material (0.400 inch deep by 1.560 inches wide) on the larger-size vanes. This considerable stock removal is done in one grinding operation to eliminate the need for refixturing the work-pieces, which would create problems in maintaining the precise tolerances specified.

Production of the compressor vanes is further complicated by the fact that the airfoil cross-sections are thinner at the center than at either end. This introduces the possibility that the work-piece will bend during processing, and necessitates extreme care in the design and use of the work-holding fixtures. Another requirement is that the lug ends of the vanes must be ground with a shear angle (similar to conventional

# CONTOUR-GRINDING OF COMPRESSOR VANES

**Tolerances as close as 0.00075 inch and stock removals as high as 0.400 inch are two of the many exacting requirements in the precision contour-grinding of hardened, stainless-steel compressor vanes for the Pratt & Whitney J-75 turbo-jet engines.**

CHARLES H. WICK
Managing Editor

punches) since they pierce their own locating holes through the shroud of the jet engine at assembly.

Manufacturing engineers at Thompson Products experimented with a number of different grinding operations and wheel-dressing techniques before deciding to set up two separate production lines—one for vanes up to 5 inches long and the other for vanes 5 to 11 inches in length. Dial type inspection fixtures are used for 100 per cent, dimensional tolerance checks after each grinding operation. Also, statistical quality-control methods are employed throughout the department.

Similar manufacturing operations are performed on all size vanes prior to grinding, in order to establish correct dimensional relationships on the complex geometry of the parts. Excess metal and flash are die-trimmed from the precision forged vanes in a press operation. The trimmed forgings are cut to length on a Radiac abrasive cut-off machine, removing material from the lug ends of the vanes and leaving 0.015 inch of stock for subsequent grinding.

Leading and trailing edges of the vanes are ground on a chord sizing machine, Fig. 1, designed by Thompson Products engineers and built by the Superior Machine & Engineering Co., Detroit, Mich. This sizing operation establishes the position of the leading edge on the vane for locating purposes in subsequent operations. The work-piece is located from a forged vee and projection, and is hydraulically clamped. Reciprocation and rotation of the forging between two endless abrasive belts, in a completely automatic cycle, generate the edges of the work-piece relative to the center of gravity. Resin-bonded, 80 grit, abrasive cloth belts, 5 inches wide by 133 inches long, are employed. Stock removal varies from 0.060 to 0.160 inch per side, depending on the forging size, and tolerances of plus or minus 0.002 inch are maintained.

The leading and trailing edge radii with relation to the airfoil surfaces of the vanes are established by blending the edges on a belt sander in a hand operation. To insure accurate grinding in subsequent operations, each vane is precisely positioned in a work-holding shuttle box—locating the vane with relation to the airfoil surface by means of dial-indicating gages. Then, molten "Cerrobend" (a low-melting point alloy) is poured around the airfoil section. When the alloy hardens, it forms a matrix to hold the vane in place securely. After all grinding operations have been completed, the matrix alloy is melted and the vanes removed from the shuttle boxes.

Root forms (consisting of five flat surfaces) are ground on the smaller vanes by means of Ex-Cell-O two-wheel form-grinding machines, such as the one seen in the heading illustration, having special wheel-slides. In this photograph, the wheel covers have been removed to show that

the wheel-centers are offset with relation to each other. This arrangement permits setting the blades at an angle so that one wheel can be used to grind one side, an angular surface, and the crown of the root, while the other wheel grinds the opposite side and adjoining angular surface.

In this operation, two vanes are ground at a time, and one operator attends two machines. Vane-holding shuttles are automatically reciprocated between the grinding wheels. The wheels are automatically diamond-dressed when the vane roots are within 0.004 inch of finished size. Vitrified-bond, aluminum-oxide abrasive wheels of 80 grain size are used. Initial size of the wheels is 24 inches in diameter by 3/4 inch wide. They can be used until they are 20 inches in diameter.

Tangs are formed on the root, or saddle ends, of the vanes by grinding from the solid on Norton cylindrical grinding machines that have been modified to provide an extra deep feed. Oscillating work-heads produce the required curvature in the base of the roots between the tangs. Three grinding wheels, separated by spacers, are provided on each machine, as seen in Fig. 2. The two larger wheels (24 inches in diameter) grind the outer surfaces of the tangs and the fillets at the junction of the tangs with the vane root, while the smaller central wheel (23 1/2 inches in diameter) forms the space between the tangs.

**Fig. 1. (Above) Abrasive belt chord sizing machine for grinding leading and trailing edges of vanes. Left-hand cover is swung open to show drive.**

**Fig. 2. (Right) Cylindrical grinding machine equipped with extra deep feed and oscillating work-head to form tangs on root ends of vanes.**

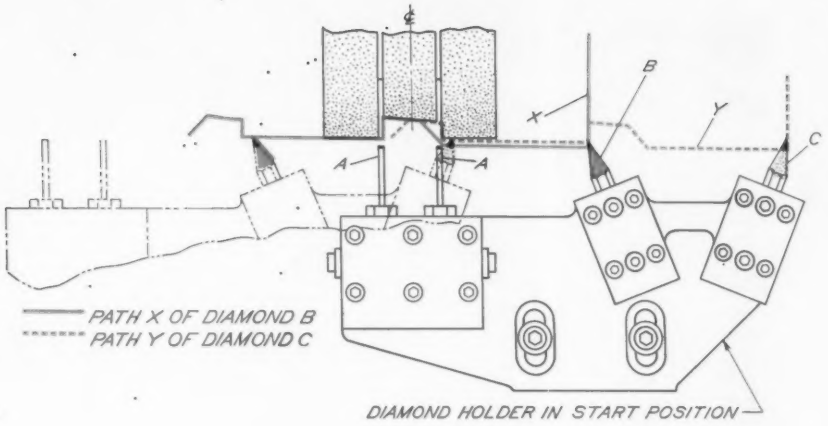



Fig. 3. In dressing the three grinding wheels on machine seen in Fig. 2, four diamonds are used —two knife type (A) and two angularly mounted (B) and (C).

In this operation, up to 0.400 inch of stock is removed in only two and one-half minutes' grinding time. The wheels are dressed after grinding from ten to twelve vanes, using a Hoglund hydraulic contour wheel dresser equipped with four diamonds, as shown diagrammatically in Fig. 3. At the start of the dressing operation, the two knife-shaped diamonds *A* are fed straight in to a depth of about 7/8 inch, thus dressing the inner sides of the two outer wheels and both sides of the center wheel. When the holder has been retracted, it moves to the left until diamond *B* has cleared the right-hand wheel. No material is removed from the wheels during this movement.

Diamond *B* is then moved inward and to the left, along path *X*, until it contacts the periphery of the center wheel slightly to the right of its center. From this point, diamond *B* continues moving to the left and toward the wheel to dress the left-hand section of the required contour on the center wheel. When diamond *B* is retracted and again fed to the left, it dresses the inner side and periphery of the left-hand wheel. As it clears this wheel, diamond *C* follows path *Y* and dresses the periphery and inner side of the right-hand wheel, and the remaining portion of the contour on the center wheel. Diamond *C* continues dressing slightly beyond the center, thus overlapping the dressing action of diamond *B* and providing a smooth blending.

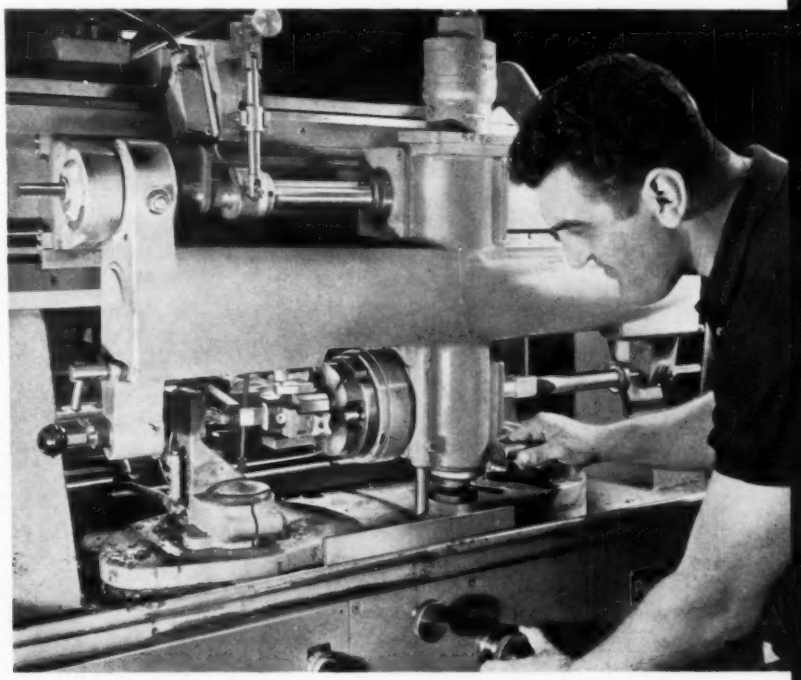


Fig. 4. Airfoil surfaces on lug ends of compressor vanes are finished on this automatic profile-grinding machine. Abrasive belt can be seen behind the work-piece.

Fig. 5. Internal grinder, modified to provide a reciprocating work-head and variable work speed, is also used to finish the lug ends of vanes.

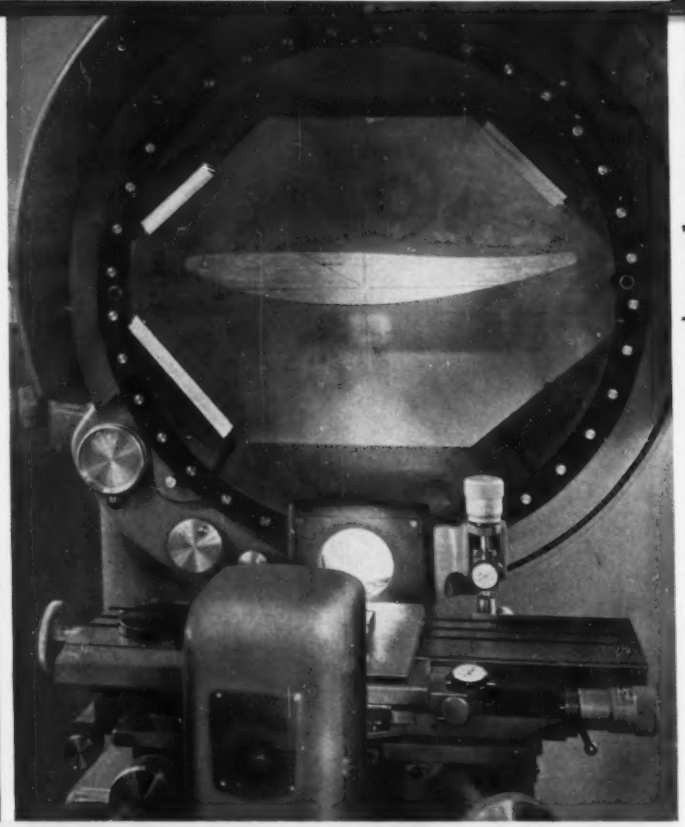


Fig. 6. Contour projector is used to inspect profile of ground lugs. Parallelism is held to 0.00075 inch, and taper is maintained within 0.001 inch.

Lug ends on the vanes are finished on Pratt & Whitney automatic profile-grinding machines or Bryant cammed internal grinding machines. On the P & W machine, Fig. 4, stock is ground from the vane lug by a 5/8-inch wide abrasive belt, which runs around a rubber-faced contact pulley located directly behind the work-piece. The vane, still held by the matrix in the shuttle box, is clamped in the lower left-hand quadrant of a pivoting work frame on the machine. Mounted in the lower right-hand quadrant, and rotating at the same speed as the work-piece, is a master cam which pivots the frame and causes its contour to be duplicated on the vane lug.

Rotary speed of the vane and master cam is varied by means of a velocity cam, seen mounted in the upper left-hand quadrant of the frame. This permits an automatic increase in the work speed when the thin leading and trailing edges are in contact with the abrasive belt. Another cam, not shown, controls the pressure with which the work is held in contact with the belt.

The Bryant grinding machines used for this operation have been modified to provide a reciprocating work-head and variable work speed. Reciprocation is accomplished by means of a cam mounted around the work-holding fixture, seen in Fig. 5. Rotary speed of the work is varied by a velocity cam which actuates a valve controlling a hydraulic motor.

A vitrified-bond, aluminum-oxide abrasive wheel of 46 grain size and K hardness is used for this operation. Wheel size, 3 1/2 inches in diameter by 1 1/4 inches wide, is very important, and is limited by the smallest radius to be ground on the vane lug. A tolerance of 0.001 inch front taper is maintained, and parallelism of the vane lug surfaces is held to 0.00075 inch. Inspection of the lug form is done on a Kodak contour projector, Fig. 6.

Finishing of the saddle and lug ends on larger compressor vanes is done on a newly installed line of seventeen Thompson Model C surface grinding machines equipped with Hoglund dressers. Grinding of the five-sided saddle ends is done on pairs of these machines mounted in tandem—one machine in each pair being used to grind three surfaces on the saddle, and the other, the two remaining surfaces. Fig. 7 illustrates the first of these operations, with the angular work-holding fixture loaded with four matrix-filled shuttle boxes, ready for grinding three surfaces

Fig. 7. Three surfaces on the five-sided saddle ends of the compressor vanes are finished simultaneously on this surface grinder setup, four parts at a time.

on each vane saddle. Shown on the machine table in the foreground is the Hoglund hydraulic dresser equipped with a single-diamond stylus to dress the wheel after grinding about 200 vanes. The shuttle boxes are then transferred to the second Thompson surface grinder, Fig. 8, where the other two surfaces on each vane saddle are ground.

Tangs are ground in the saddle ends of the vanes on the Thompson grinder seen in Fig. 9. In this setup, five vanes are ground at a time, the work-holding shuttle boxes being held at the required angle by means of a special fixture on the grinding machine table. As is the case with the Norton cylindrical grinder used for smaller vanes, a Hoglund dresser with a four-diamond holder (Fig. 10) is employed to dress the three wheels. The two conventional, angularly mounted diamonds each dress the periphery and inner face of one of the outer wheels, and part of the periphery of the center wheel.

When the saddle ends of the larger compressor vanes have been completed, the matrix alloy is melted and the parts are removed from the shuttle boxes. Then they are mounted flat, in pairs, on another Thompson grinder, Fig. 11, for finishing the lug ends. Spring-loaded clamps are used to hold the saddle ends of the vanes so that the lug ends are exposed to the action of the two contoured grinding wheels.

Dressing of the wheels for this operation is done in two different ways. On some machines, a Hoglund dresser equipped with a double-diamond holder is used. The two wheels are con-

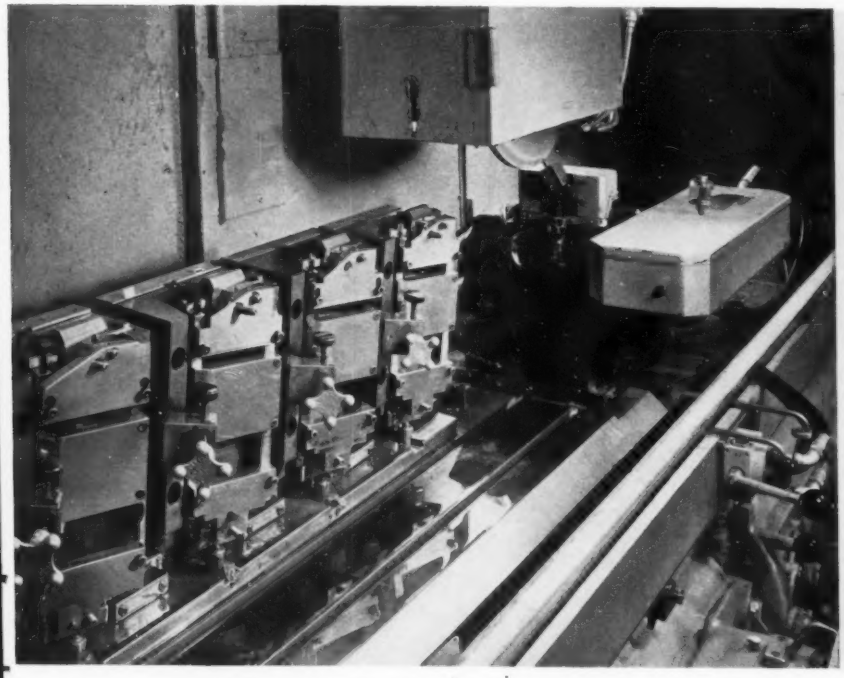


Fig. 8. Another surface grinding machine is employed to finish the other two faces on the vane saddles. Wheel is shown being dressed with a single diamond.

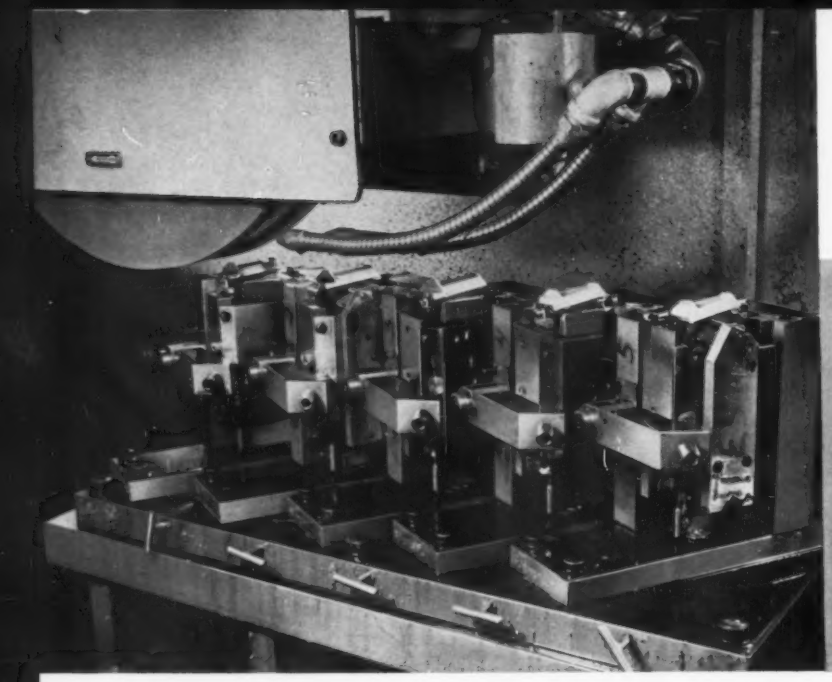


Fig. 9. Tangs are ground in the saddle ends of five vanes at one time on this surface grinder. The vanes are kept mounted in the shuttle boxes for this operation.

tinuously dressed to the required contour in one automatic cycle with the two fixed-position diamonds. Inclined planes, rather than a pantograph mechanism, are employed to control the hydraulically actuated dresser, and each diamond dresses one wheel. Vertical movement of the diamond holder is effected by a follower in contact with a contour-ratio cam (inclined plane). The horizontal slide on which this contour-ratio cam is mounted is reciprocated by a follower in contact with a contour template. Another template, having a 10-to-1 ratio, is employed to feed the main slide of the dresser.

On another Thompson surface grinder tooled

Fig. 10. Four diamonds are used to dress the three wheels employed on the machine seen in Fig. 9. The periphery of the center wheel is dressed to an angle for grinding vanes of this size.

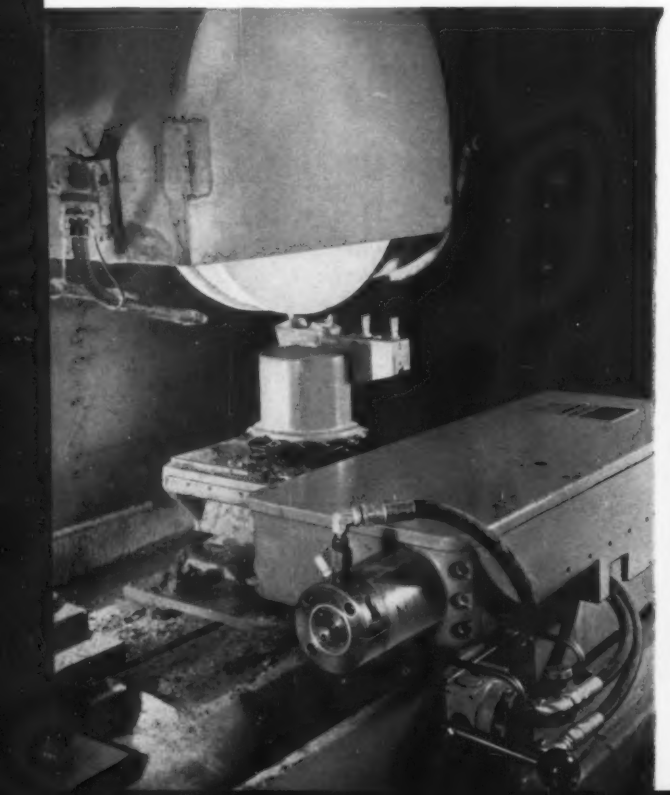
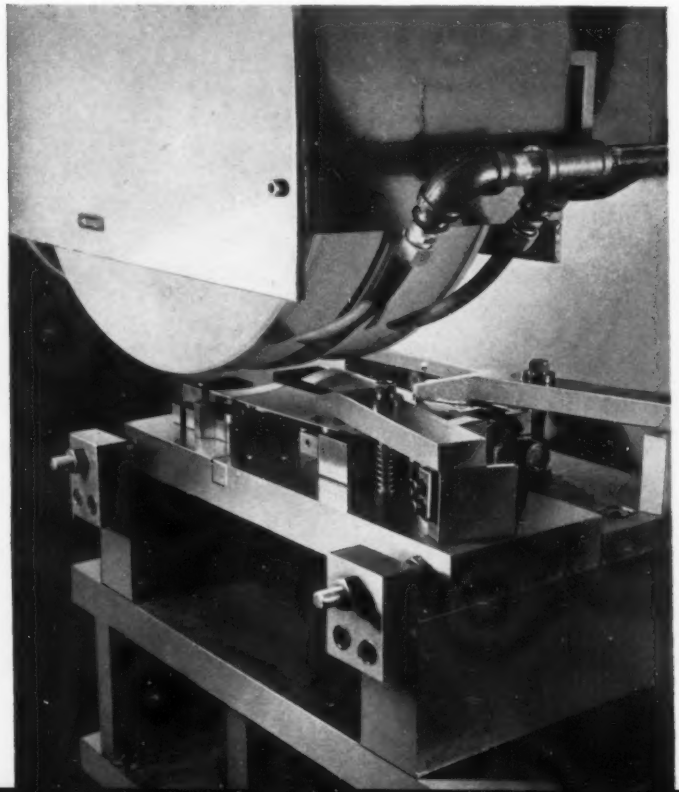


Fig. 11. Lug ends of the compressor vanes are finished on this surface grinder, after the vanes have been removed from the shuttle boxes by melting away the low-melting point alloy matrix.



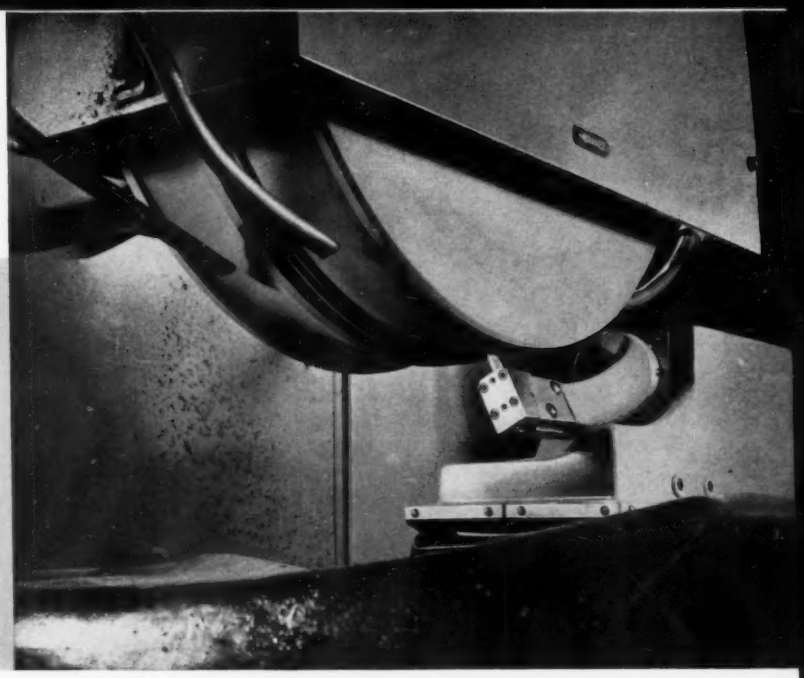


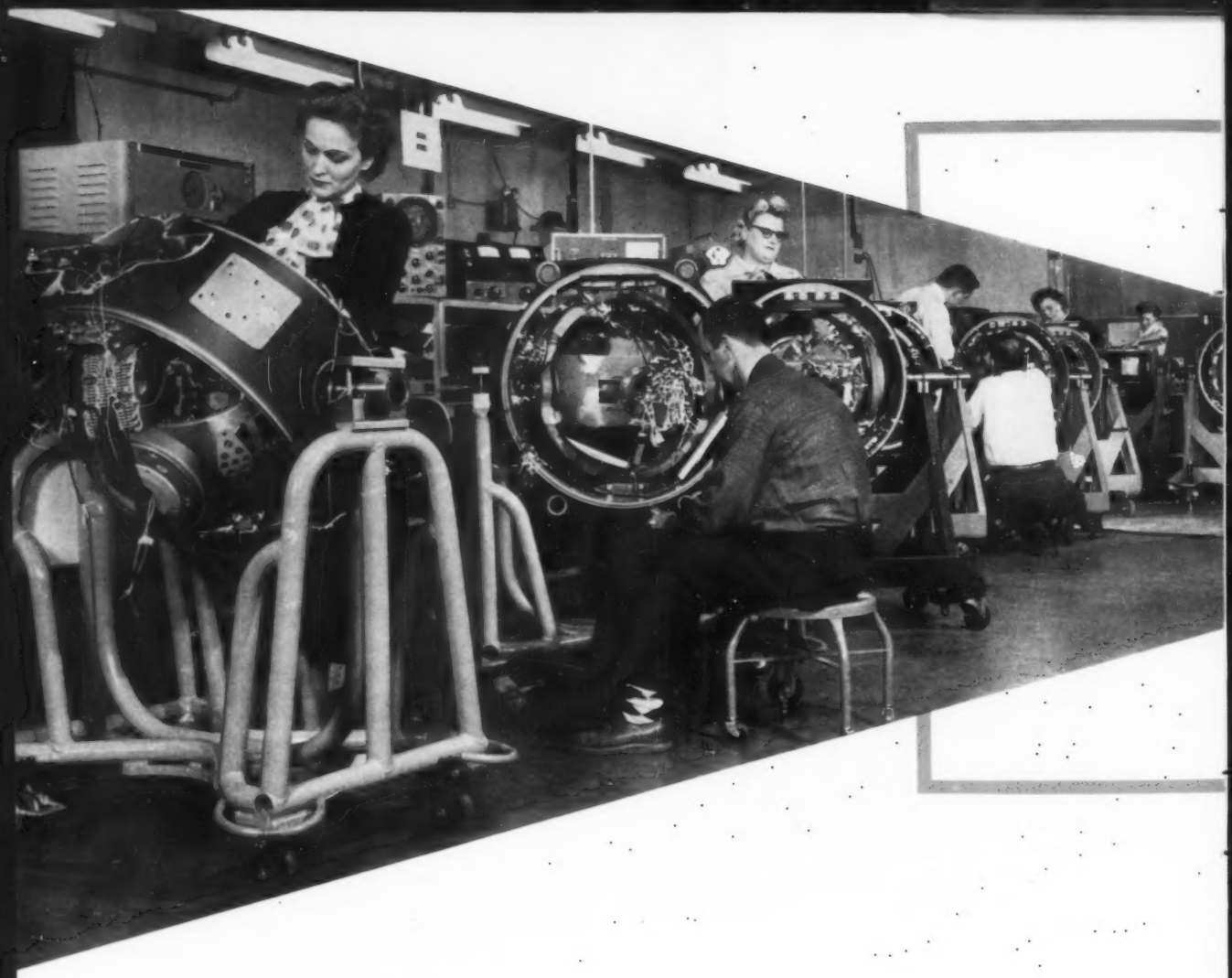
Fig. 12. Single-diamond holder is employed on this dresser to generate a concave airfoil surface on one wheel and a convex contour on the adjoining wheel.

for the same operation, a newer design of Hoglund dresser equipped with a single-diamond holder, seen in Fig. 12, is used. The one diamond generates the same concave airfoil surface on one wheel and convex contour on the other wheel as the double-diamond unit previously described. A unique rotating cam action is employed in this dresser so that the diamond is rotated about its own point and held in a position normal to the surfaces of the grinding wheels during the entire cycle.

Final grinding of the compressor vanes for the J-75 turbo-jet engines consists of producing the shear angle on the lug ends so that they can be used to pierce the engine shroud at assembly. On small-size vanes, this operation is performed on three Thompson surface grinding machines. A Hammond abrasive belt grinder is used for hand finishing the larger vanes.

Checking of the completed vanes includes a magnetic-particle inspection, performed on the Magnaflux unit seen in Fig. 13. The operator at the right clamps each vane in an air-operated pivoting fixture, which immerses the part in a solution containing magnetic particles. As the vane is lifted out of the solution, it is magnetized —the current varying from 500 to 1000 amperes, depending on the size of the part. Magnetized vanes are unclamped and placed on the conveyor, and visually inspected by the four operators at the left. Flexible hoses are provided at each station to apply more solution if required. Satisfactory vanes are stamped and stacked in baskets for demagnetizing and cleaning.

Fig. 13. Final inspection of the completed compressor vanes includes immersing in a magnetic-particle solution, magnetizing, and checking for visual cracks.



THE PROBLEM of accurately directing missiles to predetermined points in space—at the precise speed and altitude required—is being solved by the "AChiever" inertial-guidance system. This intricate system is believed to be the most accurate functional mechanism in production. It is so precise that it can sense the instant-by-instant progress of the missile, and guide it back on course if it deviates because of high winds, changes in the motor combustion, or for any other reason.

Basically, the inertial-guidance system makes use of extremely precise gyroscopes mounted on a stable platform which is isolated from the roll, pitch, and yaw of the missile by means of gimbals. At the launching site, an optical theodolite (similar to a surveyor's transit) is used to align the platform. During flight, larger gyros hold the platform steady, and smaller (accelerometer) gyros sense the missile's speed and direction. This information is fed into a computer which signals the rocket motor, when necessary, to move the missile back on course, or, at the right moment, to cut off the rocket power.

Volume production of AChiever inertial-guidance systems is under way in a new AC Spark Plug plant at Oak Creek, Wis., that was built with General Motors Corporation funds. The system is light in weight, compact, and relatively low in cost. It cannot be interfered with or jammed, and will not disclose the path of the missile because of any signal it sends out. Numerous successful tests have been completed, and the system is currently in use on two air-breathing missiles (the Navy Regulus and the Air Force Matador) to guide them during their complete mission. Also, it is used on the Air Force's Thor, a ballistic missile of 1500-mile range, to guide it to a point in space where it can be released from all control and fall to its target.

Manufacture of such an intricate and precise system requires unusual techniques, close-tolerance machining, and special equipment. One unique approach has been to begin work on the

# MISSILE GUIDANCE REQUIRES MACHINING TO MILLIONTHS

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**Gyroscopes of extreme precision are provided in inertial-guidance systems to accurately direct missiles to their targets. Tolerances are in millionths of an inch, gears are produced with a total composite error of 0.0002 inch, materials are stabilized by alternately heating and cooling, and ultra-precise machines are used.**

manufacturing problems while research and development were still in progress. The simultaneous working together of these three groups made it possible to start volume production ahead of schedule.

Much of the production equipment—including some of the latest machine tools acquired—has been rebuilt to attain the ultimate in accuracy. For the most precise work, the machines are cycled until they reach operating temperature before they are used. Some machines are never turned off until an entire lot of parts is finished. As much machining as possible is done in one chucking of the work-piece in order to minimize the possible introduction of errors.

Typical of the ultra-precise parts required for the inertial-guidance system is the pivot seen in Fig. 1. A tolerance of only 25 millionths of an inch must be maintained on the small-diameter end of this tiny part, and a finish of 1 micro-inch or less must be obtained on this surface, the fillet, the rounded corner, and the end of the pivot. Also, diameter *A* must be held concentric with diameter *B* within 0.0001 inch, total indicator reading.

Pivots are made from high-speed steel drill rod containing 5 per cent molybdenum, 4 per cent chromium, 2 per cent vanadium, and 6 per cent tungsten. After rough machining to tolerances of 0.0002 inch on Tornos Swiss type automatics, the parts are heat-treated to attain a hardness of 64 Rockwell C. Then, after electrochemical cleaning, the work-pieces are finished on a Hauser pivot-burnishing machine, Fig. 2.

As can be seen in Fig. 3, the pivot is gripped in a rotating collet and supported in a highly polished semicircular notch on a carbide disc. A ceramic wheel, rotating in a direction opposite to that of the work, is used to semifinish-burnish the pivot. This is actually a metal-cutting operation, since fine chips are produced and as much as 0.002 inch of stock is removed from some surfaces. A tungsten-carbide wheel is employed to finish the part. This step is primarily a burnishing

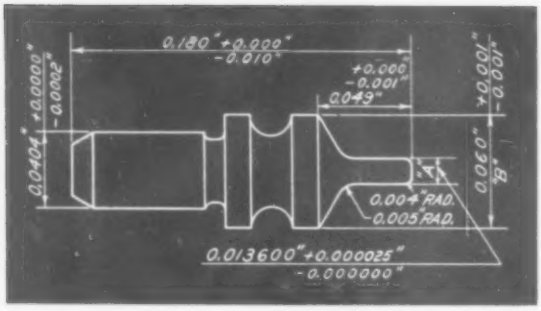



**Fig. 1. Pivot for the AChiever inertial-guidance system is produced to tolerances of 25 millionths of an inch.**

and cutting operation, and the diameter of the pivot shank is reduced only about 0.0005 inch as the result of minor cutting.

Dressing of the ceramic and carbide wheels (to obtain the required direction of cutting grooves on both the periphery and face of the wheel) is critical, and is done on a special machine equipped with a cup-shaped diamond wheel. The very fine cutting or shaving grooves are inclined at an angle of 10 to 30 degrees to the axis of the wheel. The ceramic wheel produces a surface finish of about 8 micro-inches, and the carbide wheel, the required 1 micro-inch finish. Duration of the burnishing cycle, which varies from 3 to 10 seconds, is controlled by means of an electrical timer. To obtain the desired radius of 0.004 inch, a chamfer of 30 degrees by 0.0025 inch is produced in burnishing, and then this surface is honed by hand and polished.

Gimbal rings for supporting the gyroscopes of the inertial-guidance system are aluminum-alloy castings (356-T6 alloy) approximately 36 inches in diameter by 11 3/4 inches wide. The castings, as purchased, have been solution heat-treated. When received, they are subjected to five cycles of alternate heating and sub-zero cooling to stabilize the material and relieve stresses. Locating pads are milled and holes bored on DeVlieg Jigmils and Pratt & Whitney profiling machines equipped with target type fixtures.

Precision boring of the gimbals is performed on a battery of six Heald Bore-Matics, one of which is seen in Fig. 4. Two of the double-end machines are used for rough-boring, two for semi-finishing, and two for finishing. Each machine is equipped with interchangeable work-holding fixtures, Fig. 5, to accommodate gimbals of three different sizes. These units are special in that the opposed, counterbalanced heads are aligned within 0.000050 inch, and the temperature of the cutting heads is maintained stable within 2 degrees F. by means of electrical resistance heaters which are built into the machine below the head bridges.

Each machine is also equipped with a complete set of Federal air and electronic gages used with a trammel to set up and align the work-holding fixture, and to inspect the machined part while it

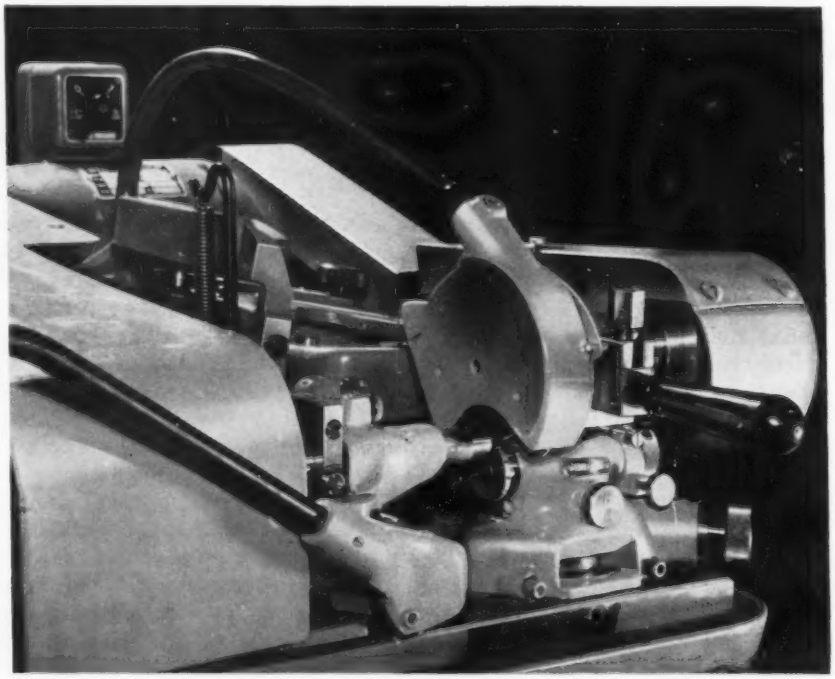


**Fig. 2. Ceramic wheels are employed for semi-finishing, and tungsten-carbide wheels for finishing, on this pivot-burnishing machine.**

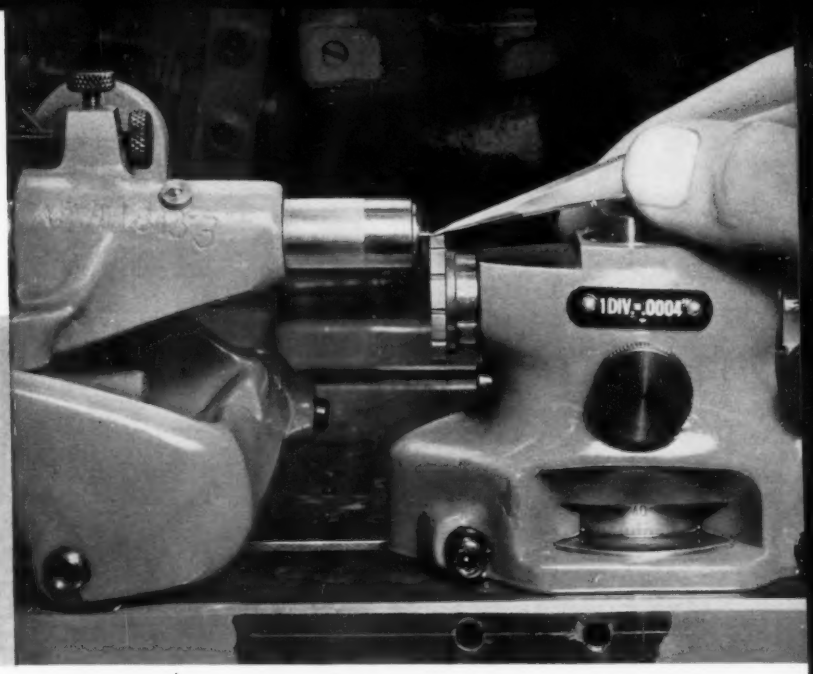



Fig. 3. Tweezers are used to place a pivot in the collet. The pivot is supported in a semicircular notch on a carbide disc.

is still in the machine. An electronic gage head is mounted on the large trammel frame (which spans the table) to check the table travel in two planes for straightness and parallelism with relation to the axes of the heads. The gaging tolerance is plus or minus 0.00001 inch over a track of 12 inches. The gage contact bears against a reference block on the table.

Holes, varying from 1 1/4 to 8 1/8 inches in diameter, are bored to the specified size, concentricity, and alignment within 0.0002 inch. Faces on the gimbals, machined with cross-feeding attachments on the cutting heads, are held perpendicular to the axes of the bores within 0.0000050 inch. The work-holding fixtures have built-in support blocks for mounting the gages, as shown in Fig. 6.

A Federal air-gage and cradle fixture is used to check the squareness of the pivot axis to the bore axis in the gimbal. A precision mandrel resting in a V-block establishes the bore axis, and AirProbe contacts, which engage pivots, are

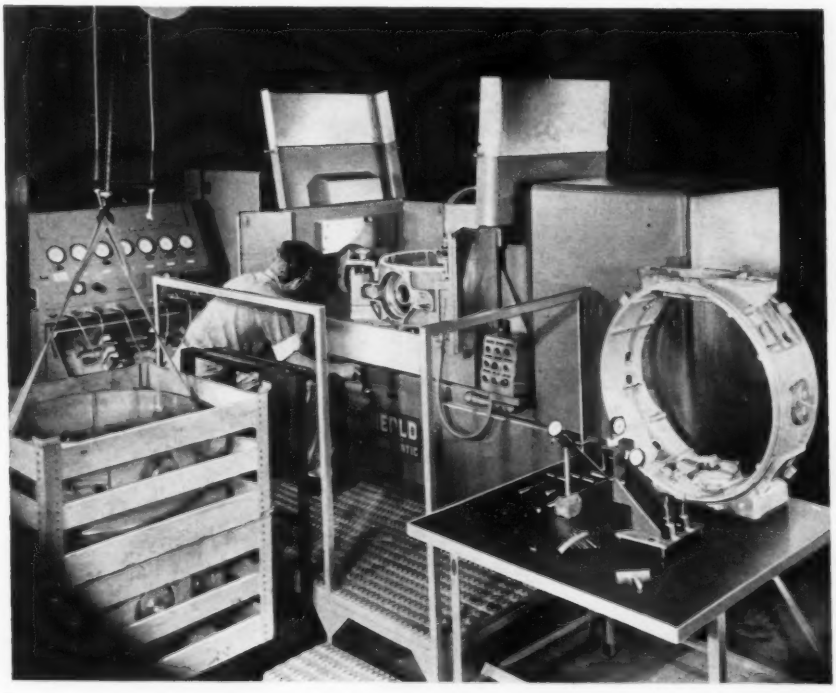


Fig. 4. One of the double-end precision boring machines employed to finish-bore and face gimbals for the inertial-guidance system.

Fig. 5. Gimbals are clamped in the precision boring machine (Fig. 4) by means of spring-loaded clamps that are tightened to a pre-set torque.

cross-paired and connected to opposite sides of the air meter. If the two axes are not at 90 degrees, the pivots will be canted, and each pair of contacts will be shifted in opposite directions from the nominal (zero) position. The unbalance caused by the shift is shown on the indicating meter.

Approximately 3/32 inch of stock is removed per side in rough-boring, 0.025 inch in semi-finishing, and 0.010 inch in finish-boring. Carbide tools, lapped to a 2 micro-inch finish, are used for these operations. The tools are rotated at 812 surface feet per minute, and fed at the rate of 0.002 inch per revolution. Only 26 seconds are required to bore and face the largest gimbal. In securing the work in the fixture with spring-loaded clamps, the total pressure exerted is limited to only 7 pounds by means of torque-controlled wrenches.

Similar operations are performed on the platforms for the inertial-guidance system by means of Ex-Cell-O double-end, precision boring ma-

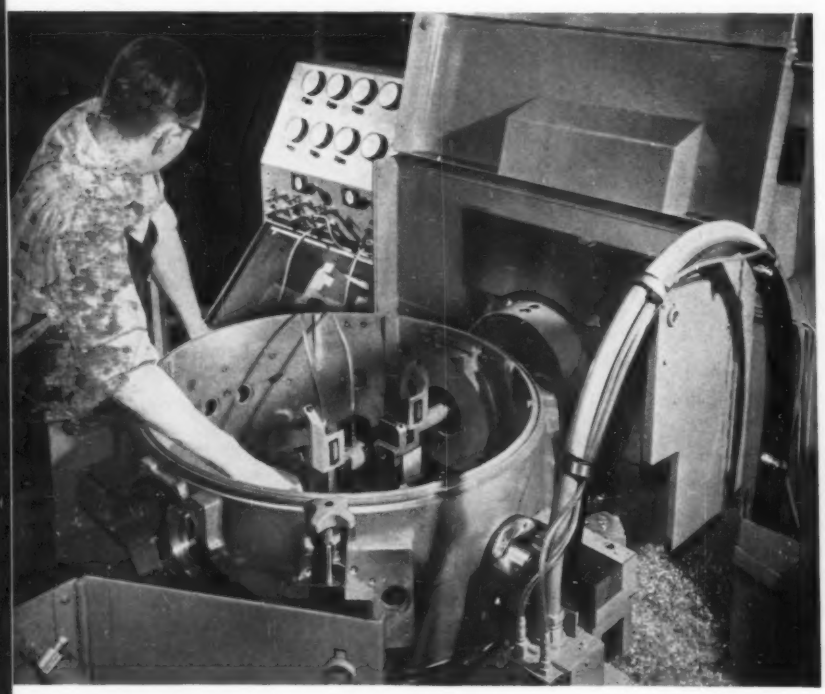


Fig. 6. Parts are inspected while they are still in the machine by placing air gages on support blocks built into the fixture.

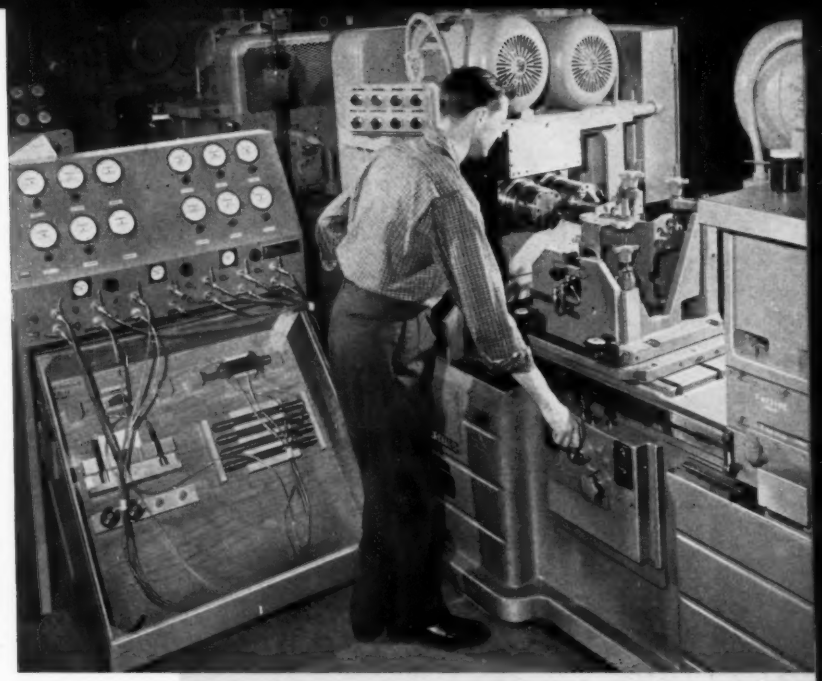


Fig. 7. Platforms for the inertial-guidance system are bored on this double-end machine equipped with a complete set of air gages.

chines, such as the one seen in Fig. 7. The platforms, cast from the same aluminum alloy as the gimbals, are box-shaped parts approximately 12 inches wide by 9 1/2 inches long and 11 inches high. Three pairs of gyro support holes, as well as a pair of pivot-mounting holes, are rough-, semifinish-, and finish-bored after the bearing caps have been assembled to the castings. Three boring operations are required for each hole because of the need for normalizing and stabilizing heat-treating operations after roughing and semifinishing.

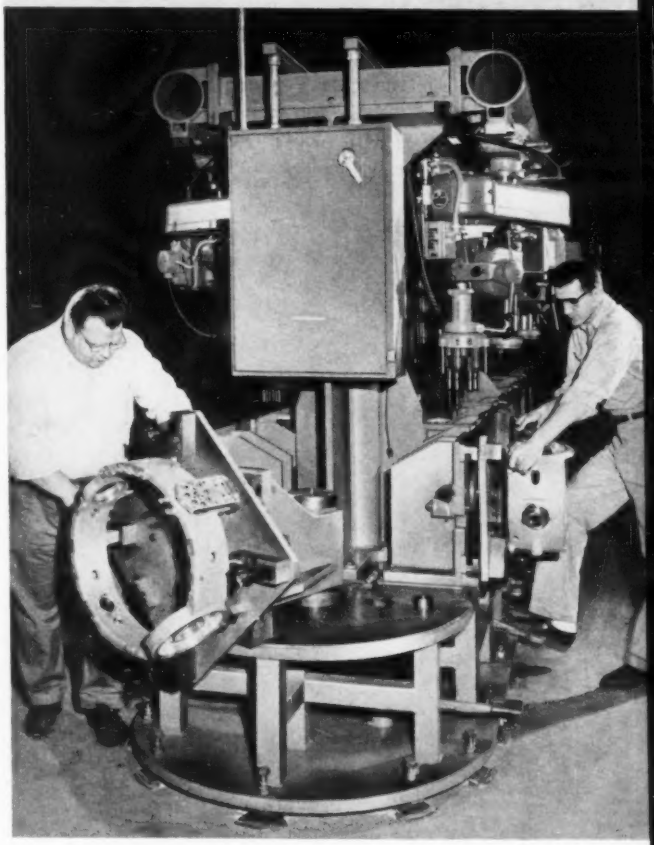
As in the gimbal machining setup, a complete set of Federal air gages is provided to set up the fixture and check the platform. Stock removals are about the same, and similar tolerances are maintained. Lapped carbide boring tools are used for these operations.

A portable C-frame fixture and air gage are used to check the co-planar parallelism between the gyro mounting-rod bores in the platform. Precision mandrels are fitted into the bores to establish the axes, and V-blocks are mounted on the mandrels to reference the fixture. Spacing between the mandrels is determined by AirProbe contacts.

Approximately 360 holes—varying from 13/64 to 7/16 inch in diameter—are drilled, tapped, spot-faced, or chamfered in each gimbal ring on the special machine shown in Fig. 8. This machine, designed by AC engineers and built by the Badger Tool & Engineering Co., is equipped with eight Walker-Turner multiple-spindle heads, four along each side.

Gimbals are manually clamped by means of four pads to index-plates which can be rotated to any desired position for machining various

Fig. 8. These special machines drill, tap, spotface, or chamfer about 360 holes in gimbal rings. Work is mounted on index-plates.



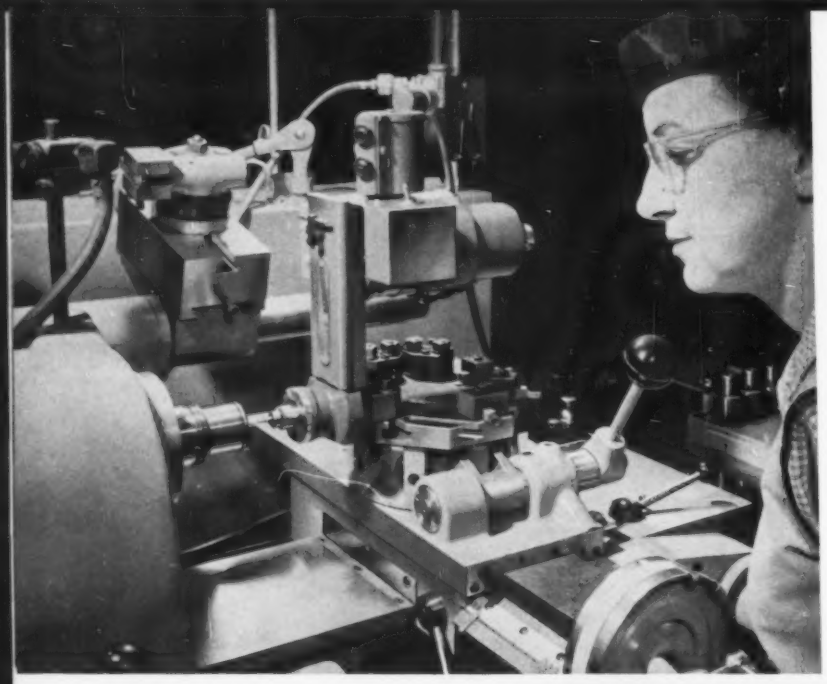


Fig. 9. (Left) Aluminum-alloy gimbal forks are turned, faced, drilled, and bored on this lathe. Finish-boring is done with a carbide burr.

Fig. 10. (Right) Standard hobbing machine for producing fine-pitch gears having a tooth-to-tooth composite error of only 0.0003 inch.

holes. The plates can be moved along vertical, dovetailed ways (provided along both sides of the machine), and clamped to ways below the head to be used. Shot pins, actuated by a combination of air and hydraulics, are used for locating purposes. To transfer the loaded index-plates from one side of the machine to the other, a pivoting type fixture is provided at each end of the machine.

Typical of the many precision machining operations performed on Hardinge lathes is the one illustrated in Fig. 9. Here, a gimbal fork made from 24S-T4 aluminum alloy is being turned, faced, drilled, and bored. Finish-boring of the 0.037-inch diameter drilled hole to a diameter of from 0.0400 to 0.0402 inch by 5/32 inch deep is accomplished with a carbide dental burr mounted in a Tru-Hole high-speed drilling attachment made by the E. F. Vilter Co. With this attachment, the tool speed can be infinitely varied from 1 to 10,000 rpm.

Fine-pitch gears for the inertial-guidance system are also made to extreme accuracies. Typical specifications for these gears include a tooth-to-

tooth composite error of only 0.0003 inch; a total composite error of plus 0.0000, minus 0.0005 inch; and concentricity of the pitch diameter with the diameter of the integral shaft, 0.0005 inch total indicator reading.

An outstanding feature of the gear production at AC is that a standard Barber-Colman No. 6-10 hobbing machine, Fig. 10, is employed, and subsequent grinding or shaving are not required. The only thing special about the machine is that painstaking care was taken in its manufacture, and its parts were selectively assembled by skilled workmen to insure the necessary rigidity and indexing accuracy. Accuracy is guaranteed to 0.0002 inch adjacent spacing and 0.0004 inch non-adjacent spacing on a 4-inch pitch diameter, spur test gear. Similar gears have been produced on special, ultra-precise machines built at high cost, but this machine represents a much lower capital investment. The machine has a single-lead worm, carefully scraped slides, and specially selected bearings. A strict preventive maintenance schedule, including daily take-up of the bearings, is adhered to.

In the setup illustrated, a spur gear of 100 diametral pitch having 540 teeth is being hobbed. This gear is made from Type 410 stainless steel having a hardness of 26 to 32 Rockwell C. Since the gears are only 0.093 inch thick, the blanks were originally made by stamping. However, too much distortion was encountered, and the blanks are now cut off from centrifugally cast bars and ground with good results.

Carefully selected hobs, Class AA or better, are used. Completed gears are checked on a Fellows No. 4 Red Liner by rolling the gears in mesh with a master. Any variation in center distance is recorded on a paper chart, as well as being shown on a dial indicator. Pressure between the master and the gear being tested is adjustable.

Gyroscope parts are carefully deburred. This work often requires more time and attention than are needed to machine the components. As seen in Fig. 11, 30-power microscopes are used to detect burrs and foreign particles, and a complete set of dental tools are employed for their removal. Vapor-, shot-, and sand-blasting are also used for this work.

Inertial-guidance systems are assembled in dust-free rooms that are kept surgically clean. To aid in maintaining cleanliness, employes wear nylon hats, smocks, and shoe covers. A slight pressure of filtered air is maintained in the glass-enclosed, temperature-controlled assembly rooms. The temperature of master gages, as well as the work-pieces, is allowed to stabilize before checking. Assembled systems are checked in raceways which can be compared to fine electro-cardiographs and which simulate a missile in flight. Movements as little as one millionth of an inch could cause enough unbalance to be detected and rejected by the quality-control division.

**Fig. 11. While the inertial-guidance system parts are observed under a 30-power microscope, burrs and foreign particles are removed with dental tools.**

# LAPPING 4920-Pound Weldments for Radar Systems

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ALTHOUGH highly significant advances are constantly being made in machining methods and equipment, the need for closer physical tolerances is a continuing problem for design and production men. In many instances, tolerances usually associated with instrument work must be held on extremely large parts.

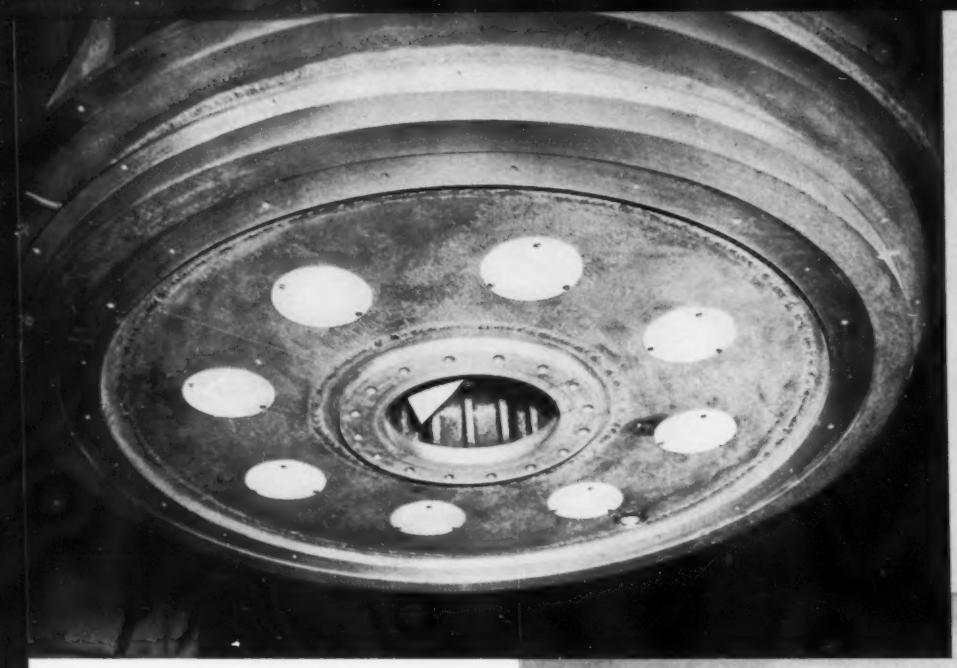
This is the case with the General Electric Co.'s Missile and Ordnance Systems Department in making a tracking antenna for a long-range radar system. Flatness and parallelism of bearing surfaces have to be held to plus or minus 0.00005 inch on revolving pedestal weldments and other parts measuring up to 85 inches in diameter and weighing nearly 5000 pounds. Such accuracy is necessary for the tracking equipment to function properly.

The use of a large lapping machine seemed to be the best approach to obtain the flatness and surface finish required on two 1-inch wide circular bearing races in the base of the pedestal, one 48 inches in diameter, and the other, 14 inches. The two are concentric, and have to be in the same plane. Both surfaces can be seen in the upper heading illustration, which is a view of the bottom of the weldment.

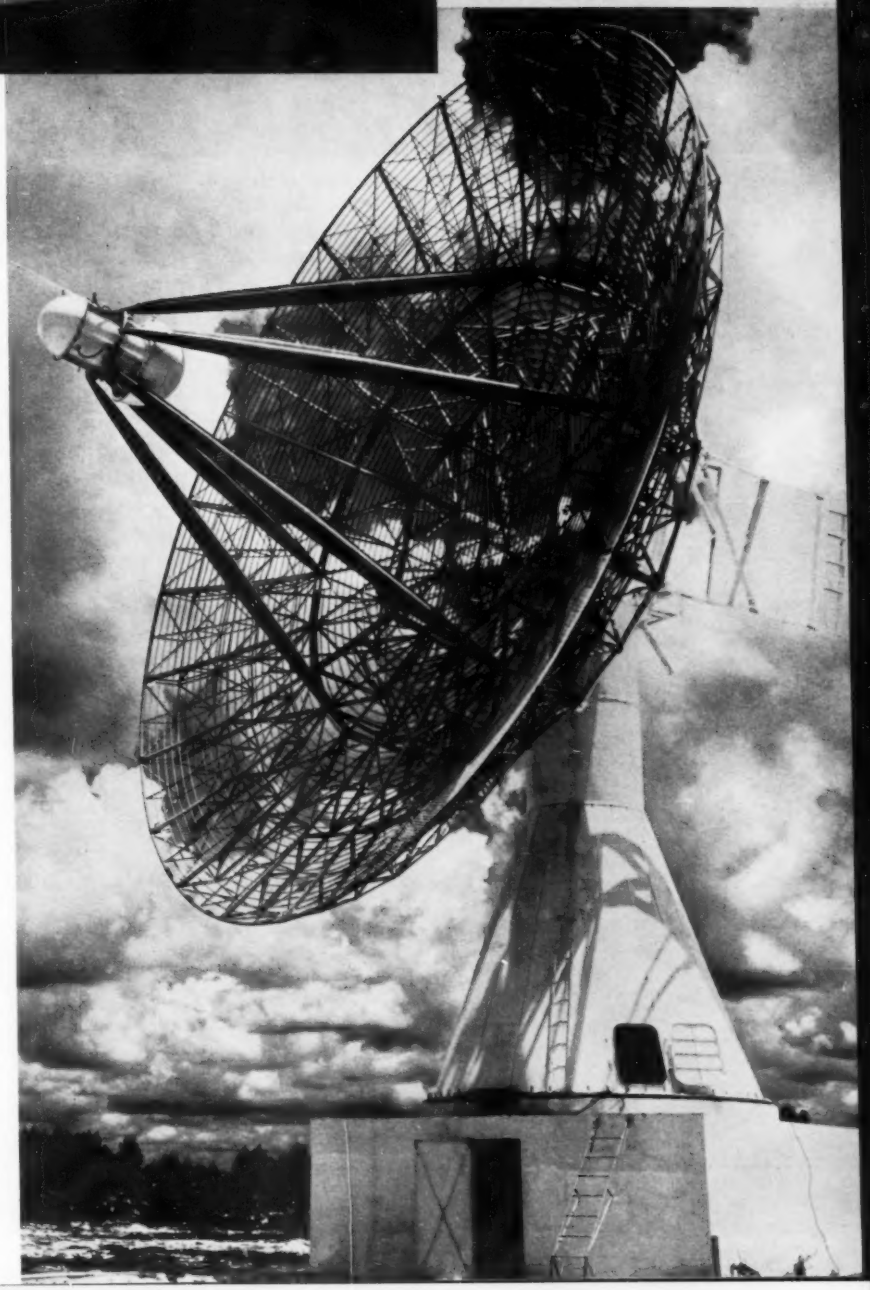
The machine tool used is an 84-inch Crane Lapmaster, seen in Fig. 1. Since the over-all diameter of the work is 85 inches, a few modifications had to be made in the design of the equipment. The outside diameter of the table was increased to 85 inches, and the inside diameter reduced to 10 inches, to make it possible to lap the smaller race. Additional clearance was obtained by moving the motor and mixing tank for the compound farther back from the table. To provide an environment for precision machining and measurement, the manufacturer recommended that the machine be installed in an enclosed air-conditioned area. This was done, and the temperature of the room controlled within 1 degree F.

The chief problem encountered during the operation is created by the 4920-pound weight of the work. Instead of the generally acceptable lapping weight of 3 pounds per square inch, the 84-inch diameter weldment places a weight of 30 pounds per square inch on the table when in full contact. What is more, when first set on the table, only three points are in contact, so a considerably greater weight per square inch is applied. To overcome this, the work is supported from a jib crane. A dynamometer on the crane hook indicates the weight placed on the table.

During the lapping, the weldment is positioned off-center to the table and is free to turn. The table rotates at 30 rpm, and has a braking action against having the work reach a dangerous speed.



Two concentric bearing races on the underside of the rotating pedestal base (left) must be flat in the same plane to plus or minus 0.00005 inch. The base is a vital component of a tracking antenna (below) for a long-range radar system.



. When the lapping starts, a weight of 200 pounds is allowed on the table for one minute. As the amount of bearing surface contacting the table increases, greater weight is allowed for longer periods of time. When the surface being lapped shows full contact with the table, the work is raised and the table is trued with conditioning rings. Then the work is lapped for one minute, after which both work and table are checked. This process is continued until the table remains true after the one-minute cycle. The part is then considered ready for final inspection.

A lapping compound and vehicle were selected only after lengthy experimentation. The compound, No. 1900 aluminum-oxide grit, produces a surface finish of 4 micro-inches. The lapping vehicle was provided by the builder of the Lapmaster, the Crane Packing Co. Best results were obtained with a mixture of one-half pound of the compound to one gallon of the vehicle. During the lapping, the mixture flows

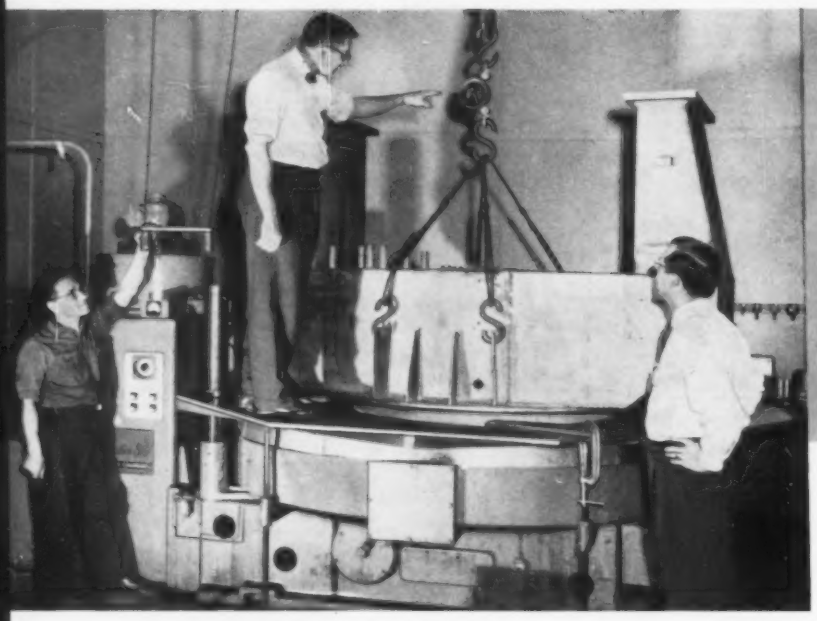


Fig. 1. During lapping, the bulk of pedestal's weight is borne by a jib crane. Crane hook and dynamometer appear above pedestal.

from the tank through tubes onto the table, where it is distributed uniformly. Radial serrations in the table serve as collectors for spent grit.

The conditioning rings, made from the same cast-iron alloy as the table, revolve around their own axis as a result of the table rotation, yet do not themselves rotate with the table. This is done by confining each conditioning ring in a yoke which is fastened to a rim plate encircling the table, Fig. 2. Trueness of the table is checked by lapping the three small brass discs seen inside the ring and inspecting them with an optical flat.

(In most lapping applications, the work is small enough to be contained within the rings, so that table truing goes on simultaneously with the lapping. This is entirely practical, since the rings wear the table surface faster than the work does, and thus maintain its accuracy. In Fig. 3, for example, the base of a bearing cap is shown being lapped inside a conditioning ring.)

Before lapping is begun, it is necessary to inspect the table sectors to make sure they are free from residual magnetism. Experience has shown that even slight magnetism is a detriment to attaining flatness. Most magnetism is picked up from parts that have been surface ground in magnetic chucks and subsequently were not demagnetized completely.

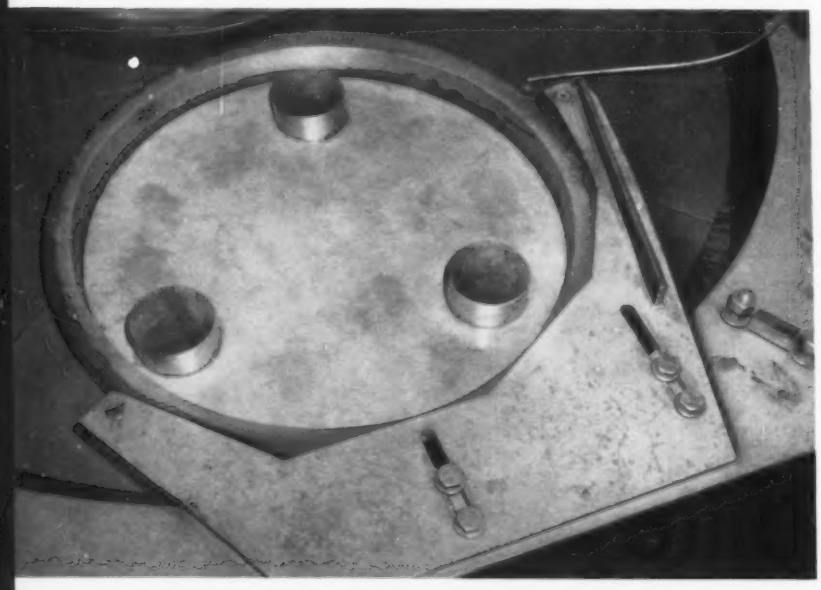


Fig. 2. The trueness of the lapping table is maintained by conditioning rings which revolve on fixed centers while the table rotates.

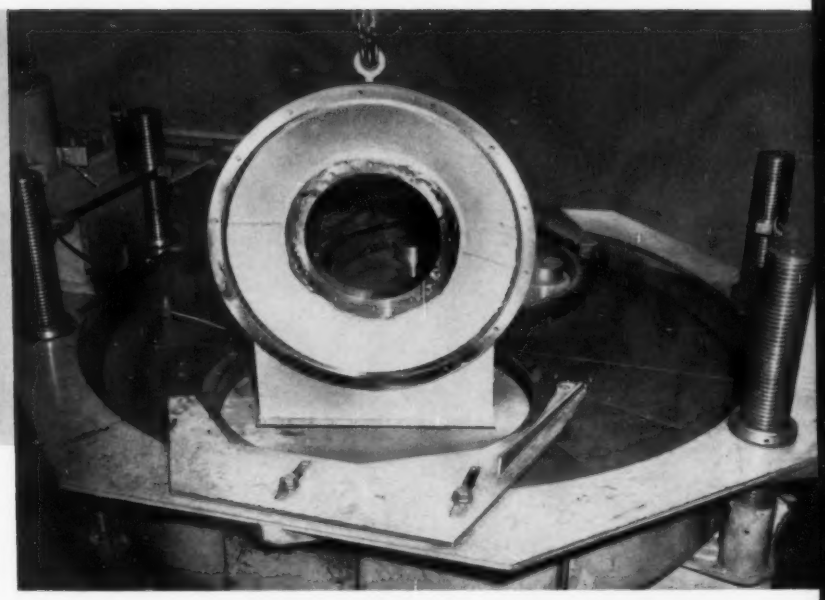


Fig. 3. Since the surface of the bearing cap to be lapped fits inside the conditioning ring, the rotary table is trued at the same time.

A 60-cycle demagnetizer is ordinarily adequate. But because of the precision required of the bearing surfaces, each sector was demagnetized individually by placing it in a 44,000 ampere-turn direct-current solenoid. The direction of magnetism was alternately reversed to successively lower values until the residual magnetism was negligible.

To double-check the flatness of the bearings, a large laboratory-grade granite surface plate was obtained. It was lapped to the best possible flatness by the supplier in his plant, and later, when installed in the same room with the Lapmaster, it was inspected by a Profilometer and found to be within 0.00015 inch over a 48-inch diameter while bearing a 4700-pound load.

The surface plate was laid out as a large wheel with twelve spokes, as in Fig. 4. Both bearing races were then compared with the surface plate, using a Sheffield air gage having a 5000 to 1 amplification. Through the use of the two methods—comparison with the surface plate, and inspection of the brass discs with an optical flat—it can be determined whether flatness has been attained to within plus or minus 0.00005 inch. How much closer this is to a true plane can be determined only when more precise checking equipment becomes available.

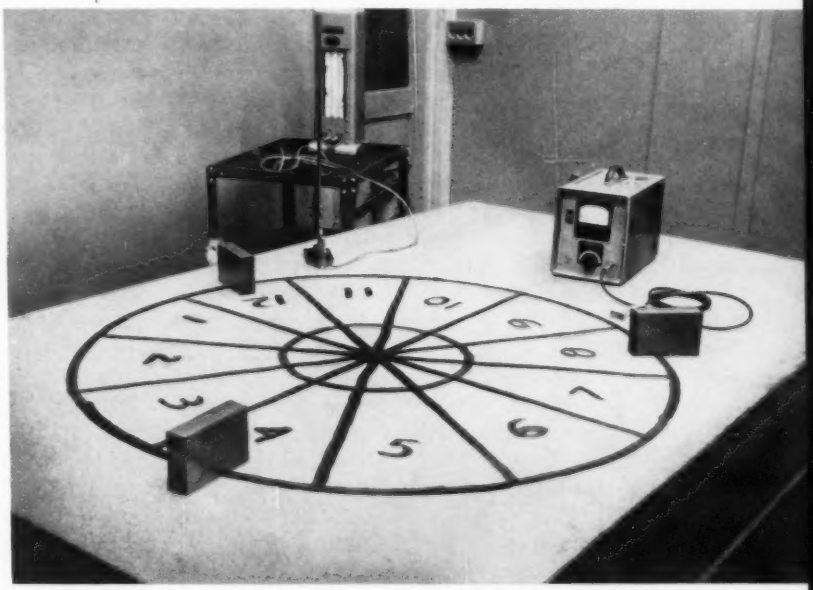
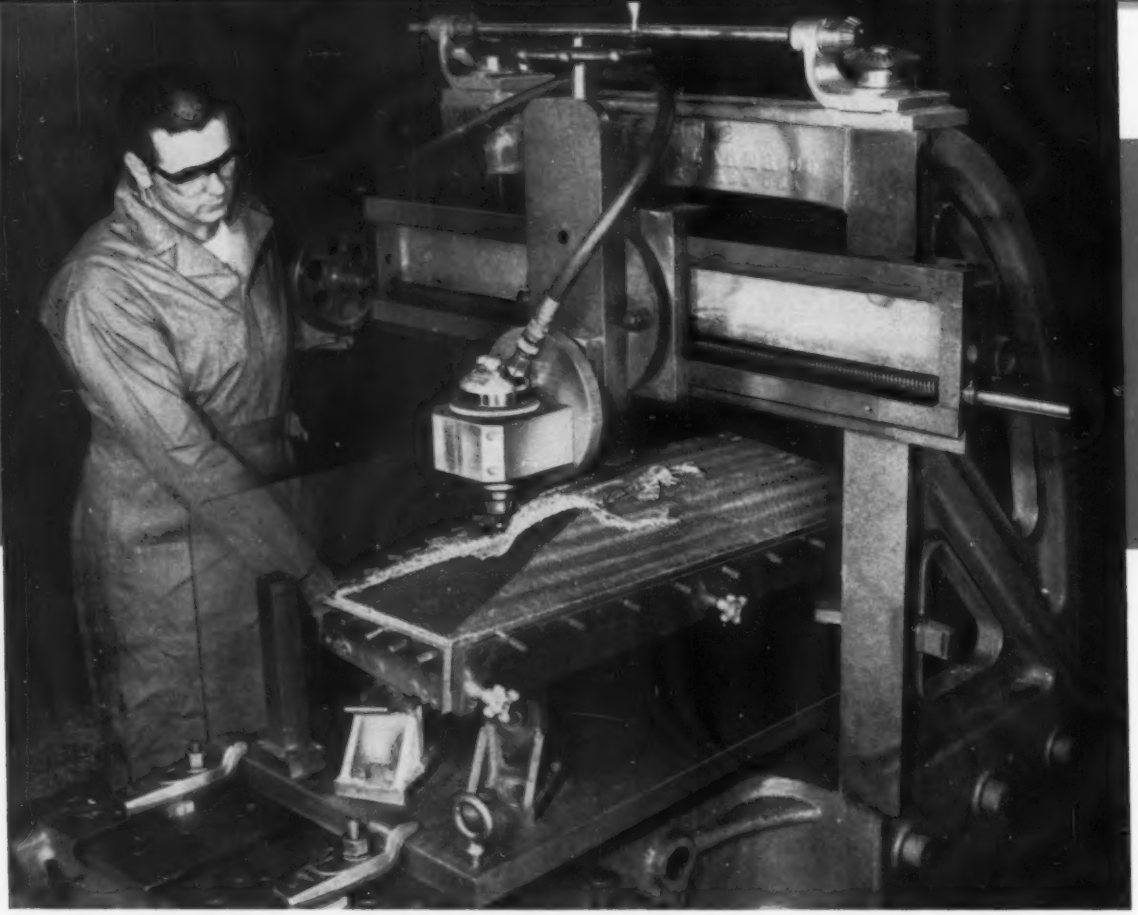


Fig. 4. Flatness of the bearing races is compared with the surface plate layout by means of a Profilometer and a Sheffield air gage.



THE MANUFACTURE of aircraft structural members by bonding metal to metal, and metal skins to honeycomb cores, is a comparatively new art. Ten years ago the thought of flying in a "glued-together," high-speed airplane would have made most people shudder. Today this is no longer the case, particularly among those who have knowledge of advances in the field of adhesive bonding and those who have justifiable faith in the products of the aircraft industry.

Bonded structures have many advantages over the so-called conventional structures. From the viewpoint of weight-strength ratio, the advantages are outstanding: fatigue life is much greater, and clean airfoil surfaces are more readily obtainable. Honeycomb structures enable engineers to design the thin wings of today's aircraft, whereas extremely thin wing sections would be difficult, if not impossible, to fabricate from spars, ribs, and skins.

In the three years that have passed since the Northrop Division of Northrop Aircraft, Inc., Hawthorne, Calif., started on an extensive program of fabricating honeycomb-bonded structures, tremendous advances have been accomplished. This article will deal primarily with the progress made in machining the aluminum honeycomb cores. This called for a great deal of ingenuity on the part of the production personnel in view of the fact that the aluminum sheets which are formed into honeycomb cores are frequently only 0.0007 inch thick. The heaviest sheet metal used for this purpose is only 0.002 inch thick.

The honeycomb cells range from 1/8 inch hexagonal to 3/8 inch. Obviously, from the machining standpoint, the honeycomb cores are exceedingly fragile. The lightest sections weigh only 2.3 pounds per cubic foot, and the heaviest sections, 8.1 pounds per cubic foot. The skins to which honeycomb cores are bonded range from 0.008 to 0.025 inch in thickness.

From this fragile material all sorts of shapes must be machined, including wedges that taper down to zero. Cutouts, steps, and double reliefs must be produced—all within tolerances as close as plus or minus 0.003 inch. In some cases wedges are formed on presses. The cells must collapse equally so that the height of each cell remains approximately the same.

At first it was believed that the individual cells had to be reinforced in some manner preparatory to machining operations so that the surrounding fins would not bend over with the application of a cutter. Consequently, an epoxy resin was melted and poured into the honeycomb cells.

# HONEYCOMB STRUCTURES

## Machined by Ingenious Northrop Methods

CHARLES O. HERB
Editor

The part was milled after the resin solidified. This method proved costly, and sometimes the resin could not be removed entirely, with the result that a part designed to weigh only a few ounces ended up weighing several pounds. It was finally decided that the honeycomb core could be satisfactorily machined if attached to a skin or spar. This procedure has proved satisfactory, and is the feature of present Northrop practice. In some cases, the honeycomb core is attached to a "caul plate" instead of a skin and is held on a machine by using a vacuum chuck.

Generally speaking, the honeycomb core is attached to a skin or caul plate by the use of polyethylene glycol, which is a water-soluble, wax-like material having a melting point in the range between 160 and 180 degrees F. The "polyglycol" has excellent gripping properties, serves as a lubricant in machining filled cores, enables machining at room temperature, and can readily be removed from the work by melting and washing in hot water. Also, it is comparatively inexpensive, and can be used over and over again.

The aluminum caul plates are chemically milled on one side, which gives them a pox-marked surface that is ideal for bond retention. These caul plates are placed on a machine table having hot and cold zones. They are placed on the hot zone to melt the polyglycol when a honeycomb core is to be attached to a caul plate. Then the caul plate is moved to the cold zone, the honeycomb core is pressed on, and the polyglycol solidifies quickly. Intimate contact of cores with the caul plates is assured by this method.

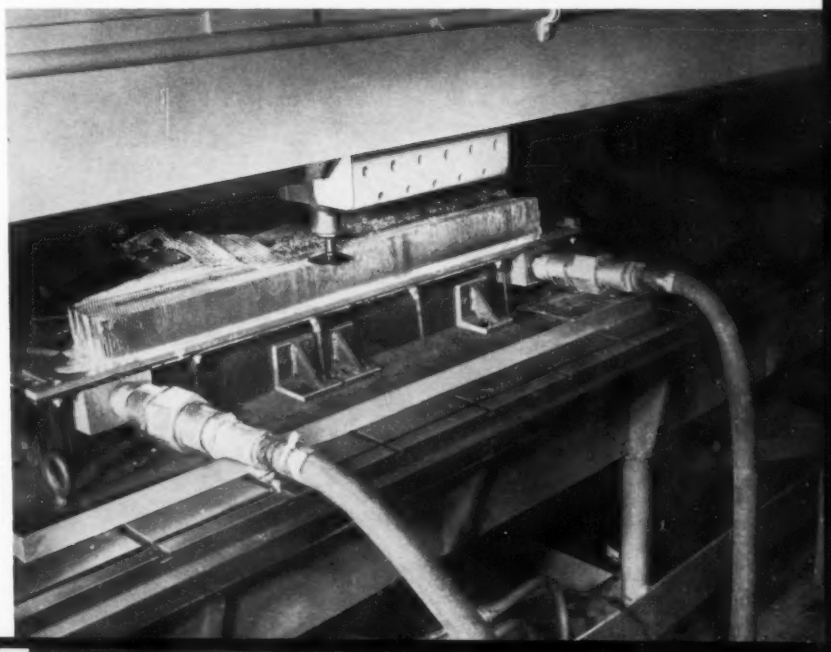


Fig. 1. Honeycomb core being machined by the use of a "truck-valve" cutter while attached by polyethylene glycol to a caul plate mounted on a manifold fixture, and heated and cooled by water.

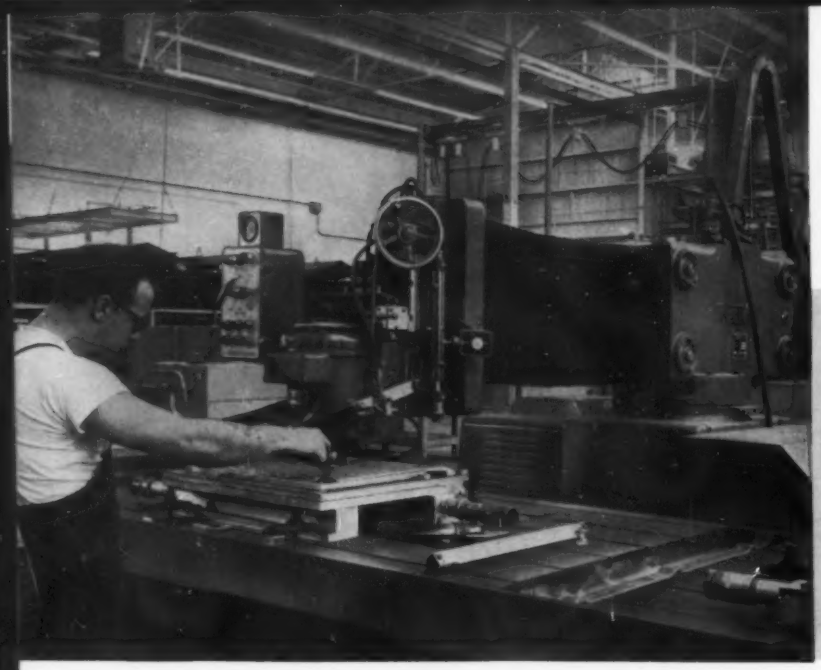


Fig. 2. Typical machining operation being performed on a honeycomb structure by a routing machine. The arm of the machine can be conveniently manipulated to carry the cutter to any point on the work.

Some machines are equipped with work-holding fixtures provided with manifolds for the supplying of hot and then cold water for the melting and setting of the polyglycol. The fixture shown in Fig. 1 is of this type. In general, however, the use of caul plates saves machine down time between jobs.

Various types of cutters were originally used for the machining of honeycomb cores, but with only fair success. Finally, the type of cutter seen on the machine in Fig. 1, which is known variously as a "bologna slicer," "mushroom cutter," and "truck-valve" cutter, was adopted for machining operations on honeycomb cores. The latter term is most descriptive. In fact, the first cutters of this type used by Northrop were ground down from truck valves. The cutters in most common use today closely resemble the early ones. They are kept razor-sharp around the circular edge and do not have any teeth or serrations around the edge. Cutters of the "fly" type, having only a circular segment for a cutting edge, are used for hogging cuts. Because of their appearance these tools are termed "propeller" cutters.

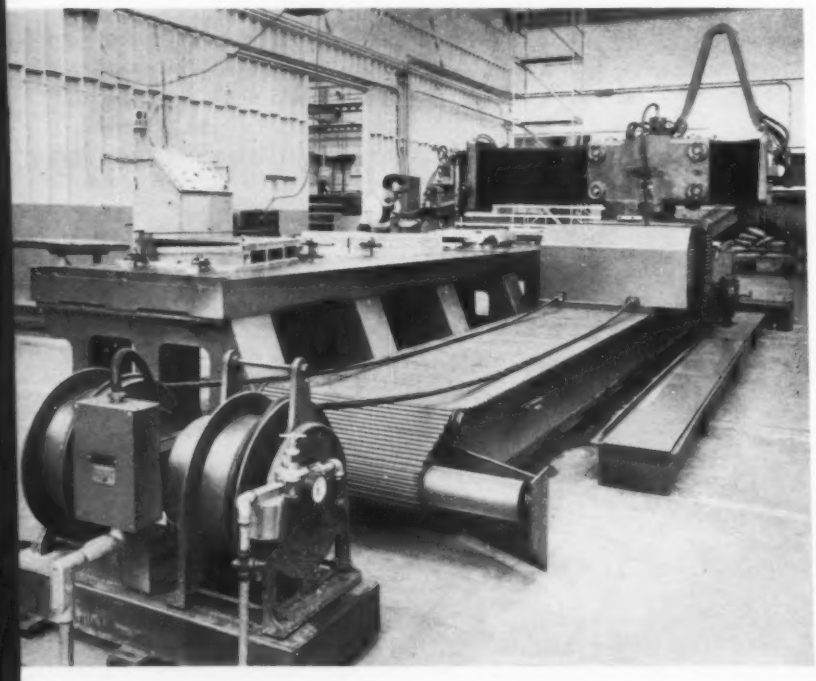


Fig. 3. The routing machine is provided with a table 25 feet long which enables setting up a number of jobs while the operator is engaged in finishing a part.

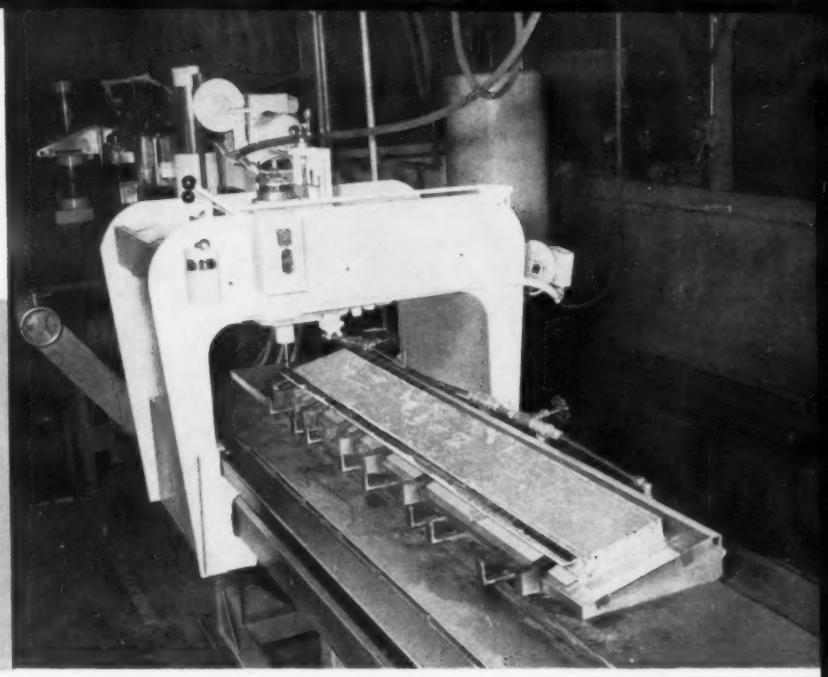


Fig. 4. Long wedge-shaped sections of honeycomb structure can be produced on the machine here illustrated, which is equipped with a slanting vacuum chuck. Cuts are taken by feeding the table back and forth.

They remove chunks of honeycomb core up to 1 inch thick at a time. Ordinarily, from 0.025 to 0.050 inch of stock is left in such operations for finishing cuts. Both types of cutters are run at 5000 to 6000 surface feet per minute.

Machines are employed in which the cutter is fed automatically across the honeycomb core to produce surfaces of varying configurations, but in some instances the cutter is guided by hand. A manually controlled machine is illustrated in Fig. 2. This is a router, with a head mounted on an arm that pivots on a carriage movable along the back of the machine table. By means of a handle seen directly above the cutter, the operator guides the latter over the work as required for removing stock to the prescribed depth.

The table provided for this router machine has a length of 25 feet, as will be apparent from Fig. 3. With a table of such length, one man can set up a number of jobs, and can remove the work that has been completed, while an operator is finishing a part. This feature considerably reduces machine down time and thus enables continuous output from comparatively inexpensive

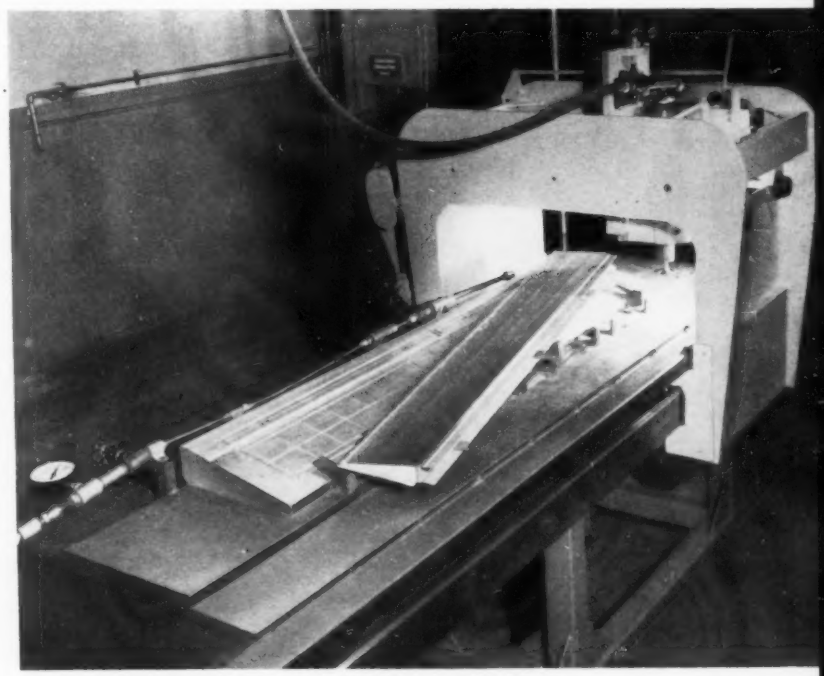


Fig. 5. Another view of the machine in Fig. 4 showing a finished wedge-shaped honeycomb obtainable from a rectangular slab, and construction of the vacuum chuck.

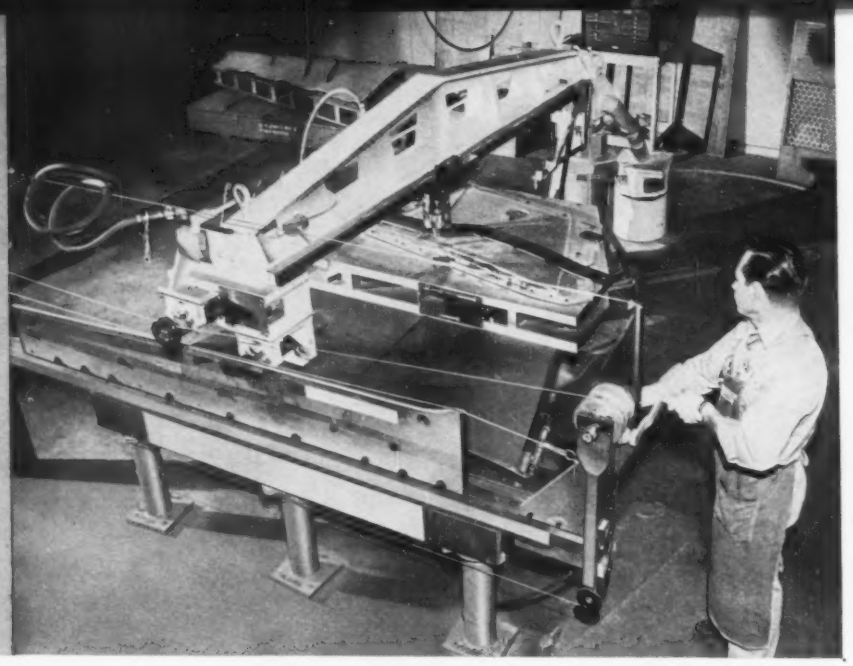


Fig. 6. "Apex" machine which enables feeding of the cutter back and forth along the per cent lines of wing sections.

equipment. The work handled on this machine is invariably mounted on caul plates.

Long wedge-shaped parts are produced by the use of the planer type machine in Fig. 4, which is equipped with a slanting fixture. The cuts are taken by feeding the table back and forth beneath the cross-rail. The fixture is a vacuum chuck, as will be apparent from Fig. 5. The latter illustration also shows the type of wedge-shaped structure that is obtainable from a rectangular slab of honeycomb core.

The most unique equipment employed in this plant for contouring honeycomb structures is the "apex" machine illustrated in Fig. 6. This machine is so called because of the provision of a swinging cross-rail that pivots on a 4-inch diameter ball on a column located in such a position with respect to the table that a wing section can be mounted on the table with all per cent lines of the wing terminating at the pivoting point, or apex, of the cross-rail.

With the cutter-head connected to a lead-screw, so that it can be fed back and forth along the cross-rail (not as shown in the illustration),

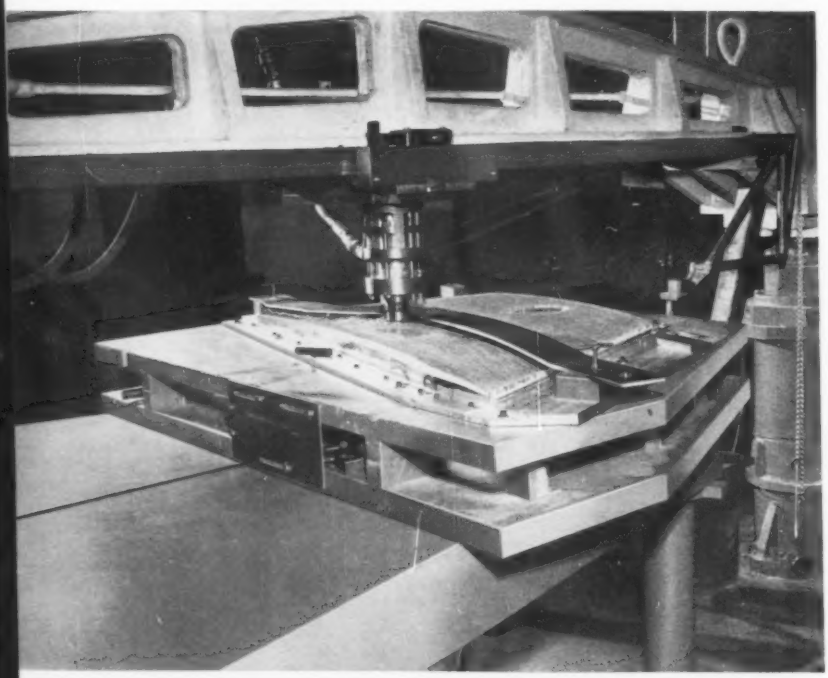


Fig. 7. Close-up view of the machine in Fig. 6 with the equipment arranged for taking step cuts transversely on a wing section.

and by intermittently feeding the outer end of the cross-rail along the far end of the table, cuts can be taken longitudinally across the wing sections to correspond with the per cent lines of the wing. These movements of the cutter back and forth on the cross-rail are effected automatically. Meanwhile, the indexing of the cross-rail is accomplished by having the operator turn the handle at the far end of the table, as illustrated in Fig. 6.

A step cut is being taken in Figs. 6 and 7 over a honeycomb core that has previously been machined to the prescribed curvature by having the cutter follow the wing per cent lines, as mentioned. In taking transverse cuts as seen in these illustrations, the cutter is guided in the prescribed path by a rolier above it, running in contact with a cam bar or template mounted across the work.

With this arrangement, step cuts or cutouts across the honeycomb structures can readily be made along regular or irregular paths. Continuous movement is imparted to the outer end of the cross-rail by turning the handle, as seen in Fig. 6.

In the heading illustration, a honeycomb core for a missile wing is being machined. The table feeds automatically back and forth beneath the cross-rail. Between strokes, the operator advances the cutter-head transversely across the rail in desired increments of feed.

Sections of honeycomb core can be conveniently cut to tapered wing shapes by means of the vertical band saw in Fig. 8. This band saw is fitted with an auxiliary vertical table which is pivoted at the top and guided by a cam at the bottom. Fig. 9 shows a horizontal band saw being used to cut a missile wing in two planes. The work fixture is of a pivoting construction.

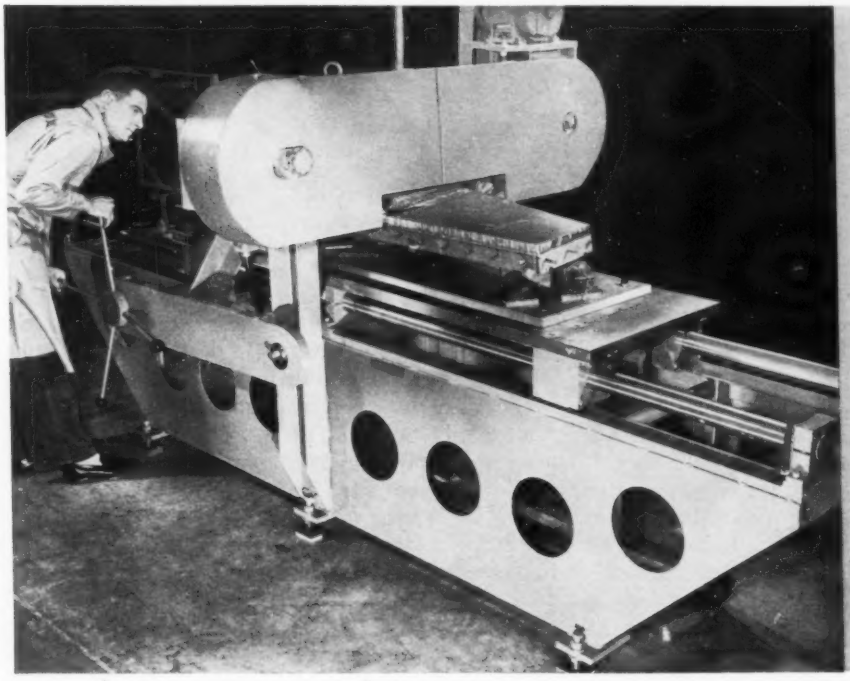
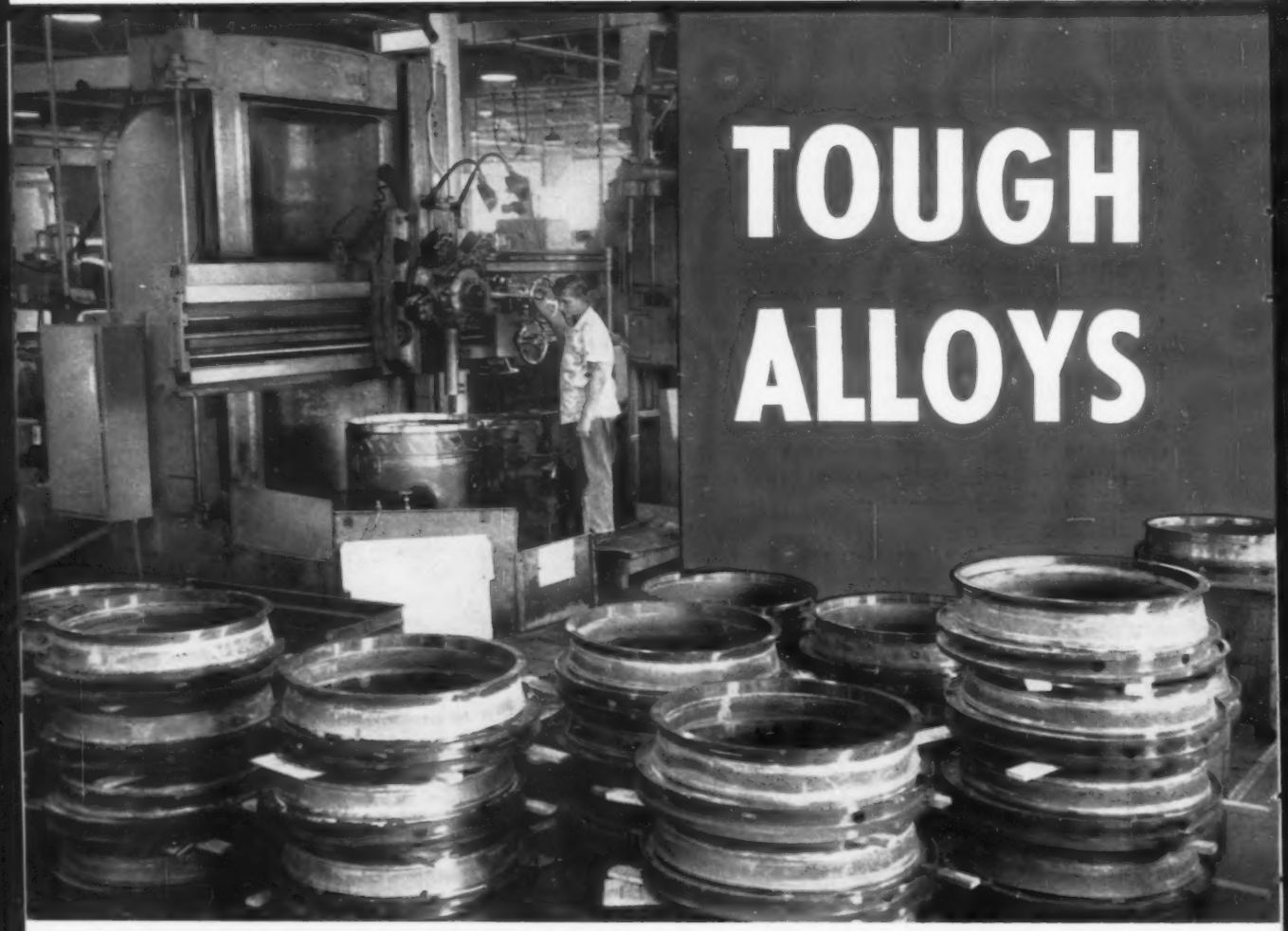


**Fig. 8. (Above) Vertical type of band-sawing machine designed to hold the fixture at an "apex" to enable cutting tapered wing shapes in the honeycomb core.**

**Fig. 9. (Left) Rough-sawing missile wing section to different planes by applying a horizontal band saw.**




# RYAN BOOSTS EFFICIENCY IN MACHINING THEM

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METALS used in today's aircraft and missiles must withstand extreme temperatures and stresses. The searing heat in jet engines, the blast of pressure in rocket motors, and the heat and consequent strain generated in nose cones and control surfaces by supersonic and hypersonic speeds, have caused manufacturers of aircraft engines and frames to turn to ever harder metals.

Generally accepted techniques and tools cannot be applied satisfactorily for machining the newer metals. Inconel, Monel, and stainless steels work-harden, glaze, and gall when handled by conventional machining processes. Tool breakage is high, and machining time soars.

A thorough investigation of new techniques and new tools for working these tough metals has been conducted at Ryan. As a result, speeds triple those which were formerly attempted are now being used on stainless steels and high-temperature alloys. Throw-away carbide inserts are extensively employed, and special tool grinders, which give finer and more accurate cutting edges, have been installed.

Three factors were covered by the investigation—cutting speed, tool cost, and production quality. It was found that finish-machining of the stainless steels was most satisfactory at speeds up to 1000 sfm (surface feet per minute), and

that rough-machining could be carried out at a speed of approximately 500 sfm. Glazing was eliminated and working time was lowered appreciably. Although these speeds were applicable to the free-machining stainless steels, high-temperature alloys were also turned out at proportionately higher speeds than had been previously used.

The higher cutting speeds were especially effective in machining large-diameter jet-engine components, such as the stainless-steel casing shown in the heading illustration and in Fig. 1, where part rigidity presented a special problem. Switching to throw-away carbide inserts and specialized fixtures yielded (in addition to increased cutting speeds) improved surface finishes and extended tool life.

Some interesting variations from conventional methods were tried during the testing program. It was noted that exceptionally high rake angles, especially for straight roughing, gave the best results. When taking interrupted cuts, a reduction of the rake angle on conventional brazed tools or the use of negative-rake throw-away tools proved very satisfactory.

Milling machine operations were also improved by the adoption of these techniques. Negative-rake carbide-insert milling cutters performed better at, or above, the cutting speeds used for turning. If slower cutting speeds are to be used, the rake angles should be increased. Milling operations should be climb-cut wherever possible.

### *Performance of Throw-Away Ceramic Tools in Various Applications*

Another machining technique that has received intensive investigation is the use of throw-away ceramic cutters. Ceramic tools possess two distinct advantages—low price and greater availability. Made of sintered aluminum oxides, these tools would not, in the event of a national emergency, cut into stockpiles of strategic materials such as tungsten and nickel.

Although ceramic tools had been used successfully in normal machining operations, little was known of their value in working high-temperature, high-strength metals. To get this information, Ryan engineers set up a special program in which these tools were deliberately tested to destruction on the tough alloys. A group of such tools produced by various manufacturers is shown in Fig. 2: *A*, Stupakoff Division, the Carborundum Co.; *B*, Diamonite Products Division, United States Ceramic Tile Co.; *C*, American Lava Corporation; *D*, Sintox Corporation of America; *E*, Vascoloy-Ramet Co.; *F*, Metallurgical Products Department, General Electric Co.

Eight materials—three types of stainless steel, four high-temperature metals, and SAE 4140 alloy steel—were used in the program. Ceramics failed early under some conditions but cut well, with longer service life, under others.

In one series of tests, ceramic tools were used to machine the flange and interior bands of a jet-

Fig. 1. Welded stainless-steel casings for jet engines. New machining techniques were developed to speed production, conserve tools, and reduce rejection and rework.

Fig. 2. (Right) These throw-away ceramic tools were purposely destroyed in a long series of tests. They were used on eight work materials, including stainless steels and high-temperature metals.

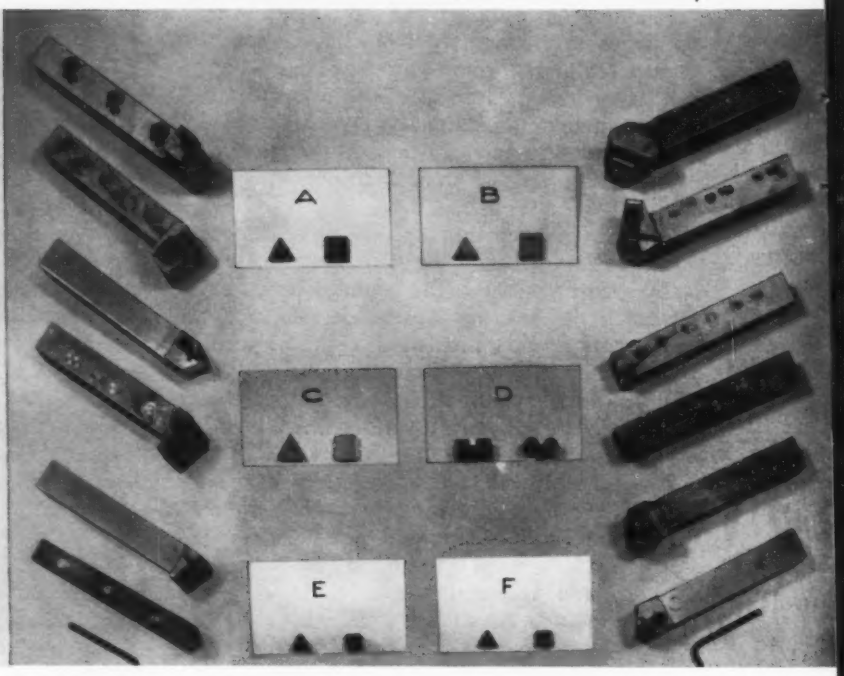
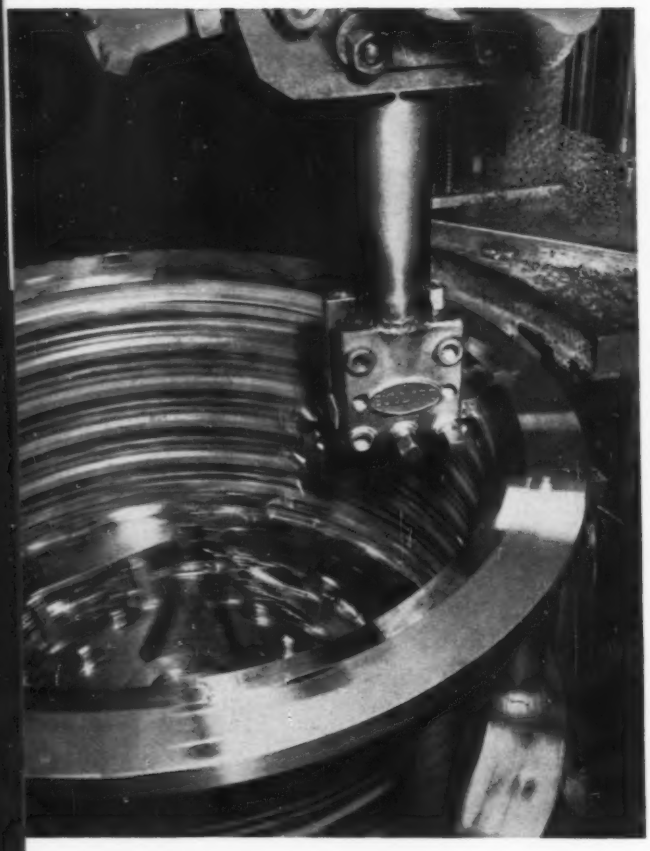



Fig. 3. (Below) Ceramic cutting tool bites into stainless-steel jet-engine casing. Shock loads imposed by welded seams caused early failure.



engine casing, Fig. 3. The ceramic inserts performed fairly well when facing the flange of the part. This was not the case when cutting the interior bands, however. Ceramics did not stand up during this operation because the welded seams caused severe damage to the inserts, ranging from point chipping to complete fracture.

Another test series on ceramic inserts involved rough- and finish-machining of a Type 347 stainless-steel billet, Fig. 4. Results, as compared to work done on the welded casing, were much more favorable. When finishing cuts were taken on the billet, it was found that ceramic tools could outperform carbide inserts—working at higher cutting speeds with comparable tool life. On the other hand, ceramics did not perform adequately on out-of-round work, for heavy cuts, or on work-hardened surfaces.

### *Drilling High-Strength Metals*

The subject of producing holes in the high-strength metals also came under consideration. With sheet metal, it was found that piercing is preferable to drilling whenever hole size is one and one-half times the metal thickness, or greater. Piercing is almost mandatory when working with the 400 series of stainless steels.

In working heavier sections and forgings, some economy was obtained by using nitrided M3

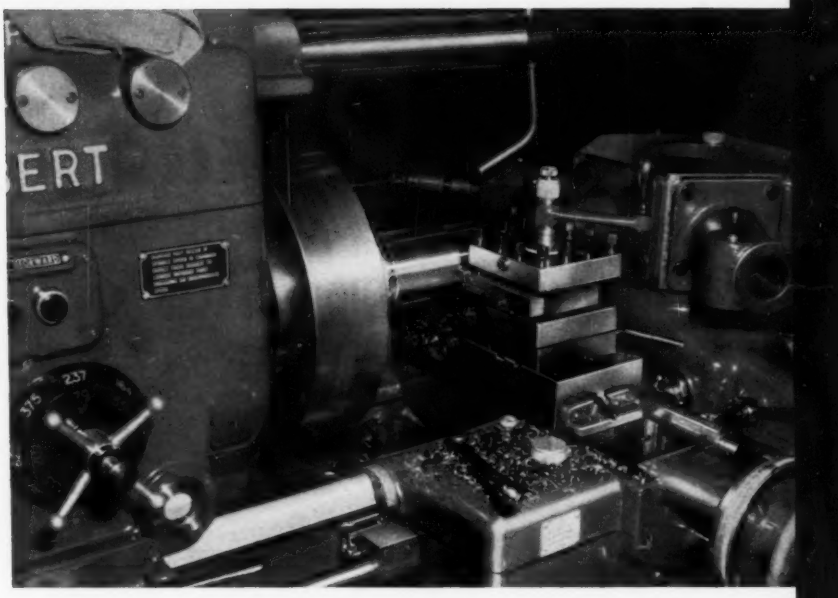


Fig. 4. Part of test in which ceramic tools rough- and finish-machined tough stainless-steel billets. This finishing cut was run at a speed of 500 sfm. Good tool life and a fine surface finish were realized.

Type 2 high-speed steel drills having a 135-degree included angle and a crankshaft grind. Although a properly thinned web drill is preferable to the crankshaft grind, consistent sharpening is difficult by offhand methods.

Small holes in high-temperature alloys were found to be extremely difficult to drill accurately. Satisfactory results were obtained by using an Elox Electron drill which produced 0.093-inch diameter holes, through 5/16-inch thick Haynes Stellite L605 (HS No. 25), to rivet tolerances in approximately seven minutes.

## Portable Broaching Equipment Used at Boeing

Close-tolerance holes in large aircraft structures, after preliminary pilot drilling, are being broached at the Boeing Airplane Co., Seattle, Wash. The portable broaching equipment shown here in operation consists of a hydraulic puller and power unit manufactured by Chicago Pneumatic Tool Co., and a broach produced by Pioneer Broach Co. The power unit is an air-driven pump supplying hydraulic pressure to the broach puller.

Tests at the airplane company have proved that hand broaching has several advantages over the previous method. Broached holes are accurate, and a good finish is obtained. Since broaching is simple, an operator can be trained quickly for production work. The process has demonstrated savings in both time and material, and rejections have been decreased in number by an estimated 90 per cent.

Holes in an airplane structure are being broached, using a portable hydraulic puller and an air-driven pump.

# VARIABLE-ANGLE HEAD

## Contours Douglas Airframe Members

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**Work-pieces with varying contours are sandwiched between two templates. A free-swinging cutter-support frame rides in contact with both templates so as to maintain a proper angular relationship to work. Internal or external cuts can be taken.**

MACHINING to varying angles along a contoured surface sets forth two basic requirements with regard to machine design: some form of relative movement between the cutter and the work and a means of setting the cutter at the desired angle must be provided. Generally, machines meeting these requirements are of the planer, or gantry, type and have a work area that is considerably greater than is necessary for the work-piece being shaped.

The contour-milling machine illustrated herewith was conceived, designed, and built by Douglas Aircraft Co., Inc., El Segundo, Calif., with a new approach to the problems associated with finish-shaping irregular surfaces. This machine was made large enough to support the work-piece only in the immediate machining area and to furnish a base for the milling cutter, control equipment, and drive mechanism. Configuration and size of the work-piece have no relation

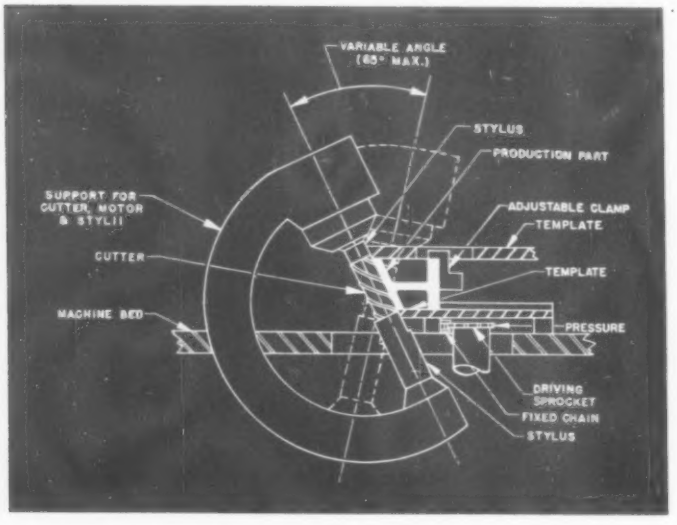



Fig. 1. View through work area during external profiling operation. Upper and lower templates are shown in contact with styli on axis of the machine spindle.

to the size of the equipment, being limited only by the surrounding space and the support stanchions provided.

Both the cutter and a direct-drive air motor are mounted on a free-swinging C-shaped support frame that extends partly above and partly below the work-table. A smooth stylus shoulder is located at both the upper and lower ends of the cutter as shown in the external profiling setup illustrated in Fig. 1. It is pressure against these styli that determines the angular position of the milling cutter.

The key to the operation of this contour-milling machine is a template-work-template sandwich. A rough-machined part is securely clamped between two template plates. This can be clearly seen both in the diagrammatic representation, Fig. 1; and the external profiling operation, Fig. 2.

Feeding of the work past the cutter is accomplished by a chain and sprocket drive. A roller chain is affixed along the entire length of the template at table height. A driving sprocket protrudes through the table and engages the chain. Forward pressure is maintained on the sprocket shaft by means of an air cylinder, thus continually forcing the template and work sandwich toward the cutter.

As the cut progresses, the upper and lower templates ride in contact with their respective styli. This guiding action forces the free-swinging cutter-support frame to assume the desired degree of inclination to the work surface. The support frame can be tilted through a maximum arc of 65 degrees. Due to the operating principle of the machine, mechanical failure or operator misjudgment results in cutting the work-piece oversize only, thus eliminating the possibility of scrap.

When internal profiling is being done, as in Fig. 3, the operating method remains the same, but the tooling is altered slightly. Here, the template contact surfaces ride within the confines of the C-frame—that is, behind the cutter. Also, a shorter ball-end cutter is used. This cutter is supported only at the upper, or motor spindle, end as can be seen in Fig. 4.

In the case of internal cutting, the roller feed chain is secured to the outer edge of the template-work-template sandwich (heading illustration). The driving sprocket is relocated to a position well behind the cutter. Pressure is applied to the sprocket shaft in a direction opposite to that indicated in Fig. 1, but always forcing the rough-machined work-piece into the cutter. Once again the upper and lower templates contact their respective styli on the spindle axis to

Fig. 2. Variable-angle head is shown contour-machining the outside surface of an airframe member. The parts are rough-machined prior to this finishing operation.

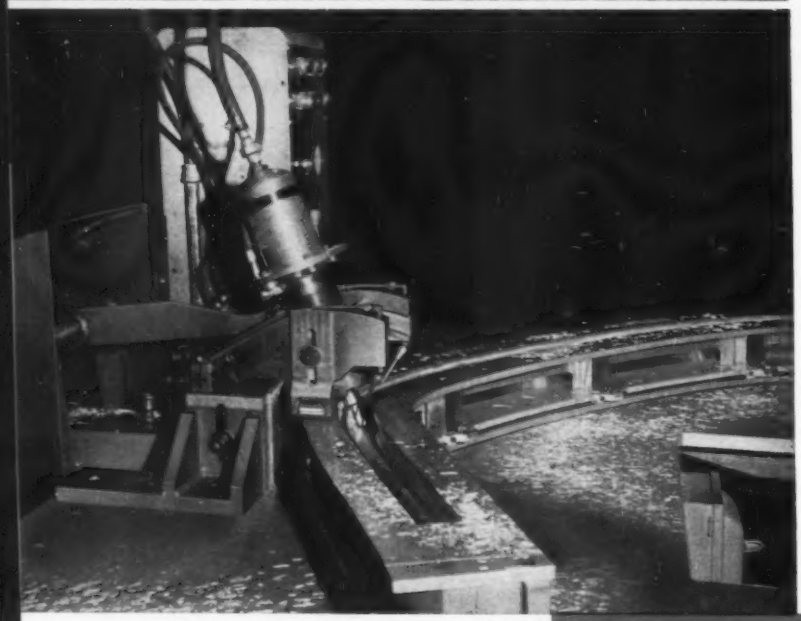


Fig. 3. A ball-end cutter is shown being employed to contour an internal surface of this airframe member. The upper stylus can be seen in contact with its corresponding template.

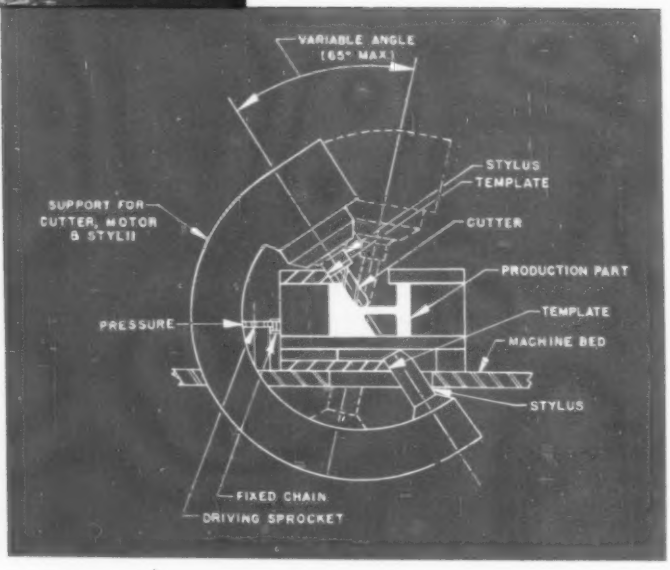



Fig. 4. Shown diagrammatically is the operation being performed in Fig. 3. During an internal cut, the driving sprocket and roller chain are located in back of work-piece sandwich.

Fig. 5. (Above) A long, continuous, external cut is being taken along one edge of an aircraft member on this small contour-milling machine. The C-shaped frame supporting the cutter pivots to conform to the contour of the template-work-template sandwich.

pivot the support frame and cutter into proper alignment with the work.

U-shapes are not the only configurations that can be accommodated by this design of contour-milling machine. In Fig. 5 can be seen a smaller unit being used to take a long, continuous, external cut on a template-work-template sandwich. The method of operation is the same as that previously described, the drive again being by means of a roller feed chain and a driving sprocket.

Production of the templates used on the contour-milling machine is an interesting procedure in itself. A portable hand-fed cutting unit is set up as illustrated in Fig. 6. The plate to be cut as a template and two contour masters that have been reproduced photographically from metal loftings are placed together. Filler blocks are used to space out these members, and the completed sandwich is clamped in a vise as shown.

The portable milling unit is placed over the sandwich and locked to the template blank by three rollers, two of which are pneumatically actuated. Two styli (indicated in Fig. 6) ride in contact with the two master contour forms to guide the movement of the cutter. The unit is advanced along the template blank by hand pressure alone.

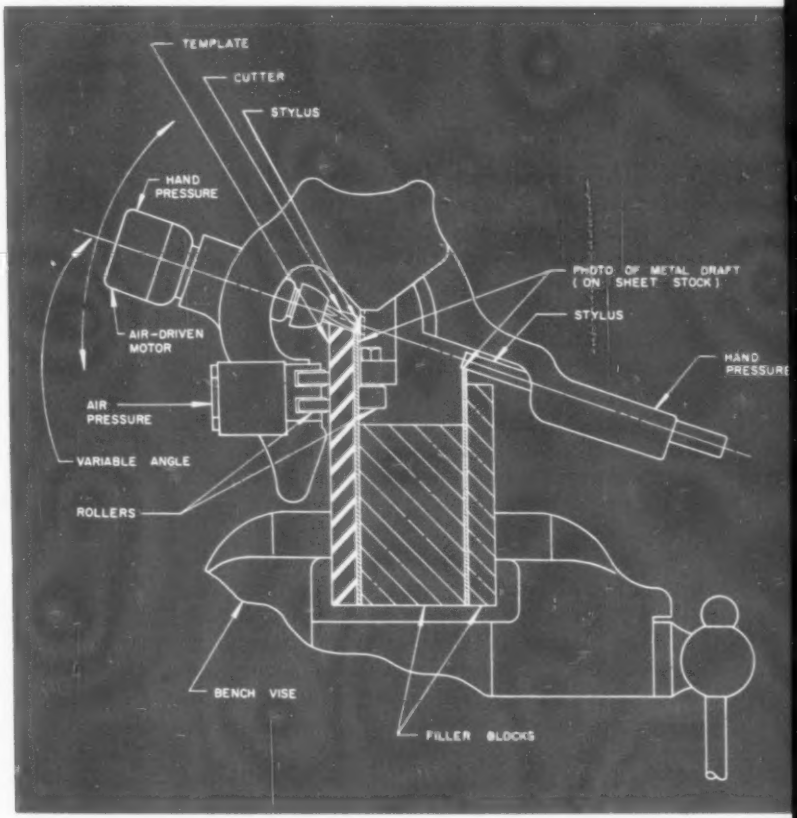
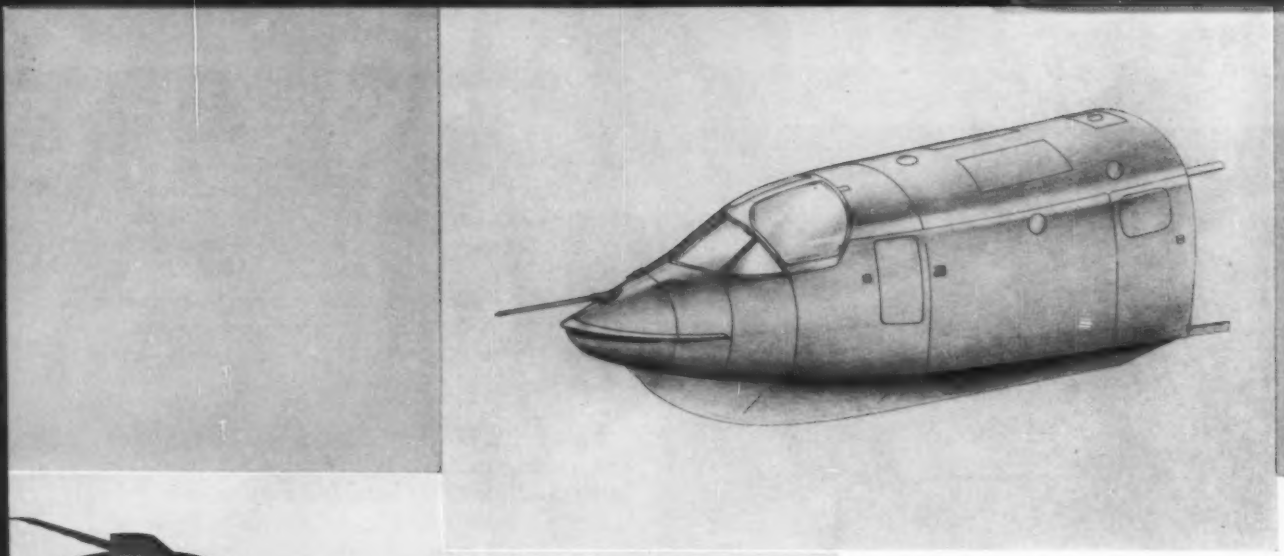



Fig. 6. (Right) Setup used to produce the necessary templates. Two styli on this portable unit ride along master contour forms and direct cutter travel along the blank.




**J. A. CASCIO**
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**The Martin Co., Baltimore, Md.**

VISIBILITY—one factor in today's military aircraft that cannot be overemphasized. With combat speeds constantly being increased, pilots must be afforded every opportunity to see, judge, and react to changing situations within their operational sphere.

It was this desire to increase visibility that prompted the Martin Co. to redesign the pilot's enclosure on the P6M-2 SeaMaster. Powered by four Pratt & Whitney J-75 turbojet engines, this attack seaplane is intended for mine-laying and photo-reconnaissance missions. It cruises at an altitude of 40,000 feet and at a speed in excess of 600 miles per hour.

Replacing the two metal escape hatches that were used above the pilot and co-pilot on the YP6M-1 is a single transparent canopy assembly, heading illustration. The canopy measures 90 inches across the lower edges and 60 inches front-to-back. Weighing 450 pounds, it is the largest such canopy ever constructed as a removable section.

Unique in the canopy assembly are the mechanical characteristics of the transparent areas. The two frangible glasses will not shatter when struck a severe blow or punctured. If a crack is initiated, it will continue across the glass in a line only so long as pressure is maintained against it. The advantage here is this: should the canopy fail to jettison before ejection, the head-rest will crack the glass and peel it back to clear an opening through which the pilot can safely pass.

It is felt that this may eventually be adopted as a prime escape method, thus allowing the canopy to be an integral part of the aircraft. In this event, a considerable weight reduction could be realized by eliminating much of the heavy-section design necessary to provide strength to the removable section.

The clean-breaking, or tearing, property of the canopy glass is obtained during its fabrication by the Swedlow Plastics Co., Los Angeles, Calif. Each transparent section starts out as a block of Plexiglas, 1 7/8 inches thick. In this normal condition the material will shatter—although in dull pieces, not in the sharp-edged fragments expected from glass. The thick acrylic-resin block is then hot-stretched to shape, bringing its thick-

# Huge Canopy Gives SeaMaster All-Around Visibility

**Hot-stretched Plexiglas forms the transparent areas of a 450-pound jettisonable canopy on the P6M-2 SeaMaster. Not only is pilot's visibility greatly improved, but the frangible nature of the hot-formed glass is an added safety feature.**

ness down to a uniform 5/8 inch. It is this heating and stretching that imparts the tearing characteristic to the glass, which makes it especially suitable for canopy applications.

### *All Assembly Steps Controlled from Master Tooling*

Each phase of the canopy assembly is controlled by fixtures or gages constructed directly from a three-section master tooling setup, Fig. 1. From the control master canopy (bottom) are constructed the fixtures used for assembling the windshield structure and the pilot's enclosure. The master canopy glass sections (top) are used for constructing the tooling and checking fixtures required to produce the Plexiglas panels.

Assembly of the removable canopy is carried out on three fixtures that have been built up directly from the master model canopy (center, Fig. 1). These are the first-position assembly and drill fixture, Figs. 2 and 3; the second-position clean-up fixture, Fig. 4; and the third-position pressure-test fixture, Fig. 5.

Exact contours on the first-position fixture are assured by molding the banking surfaces in direct contact with the master model canopy. The fixture is built up in segments, each being an aluminum sand casting. They are cast undersize and to the approximate contour required.

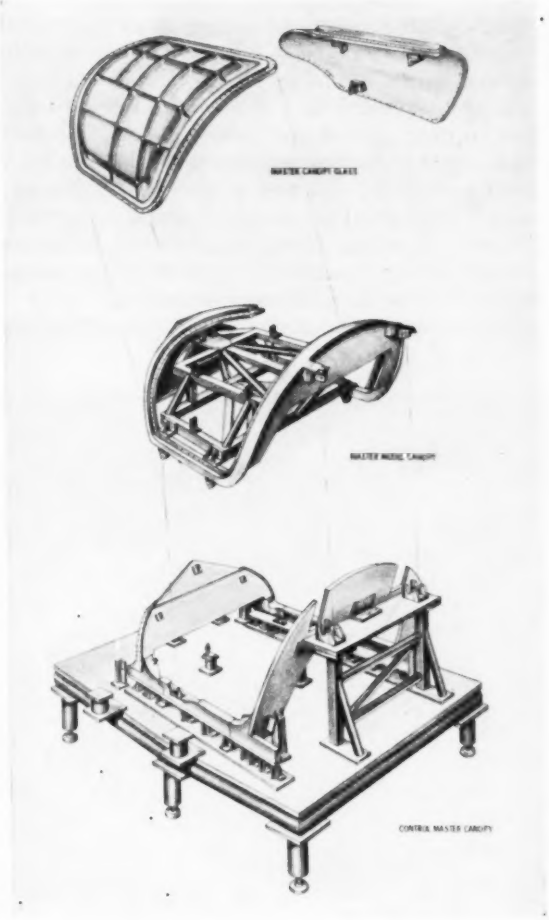

**Fig. 1. Three-section master tooling setup. From these sections are constructed the machining tools and assembly fixtures to produce pilot's enclosure canopy.**

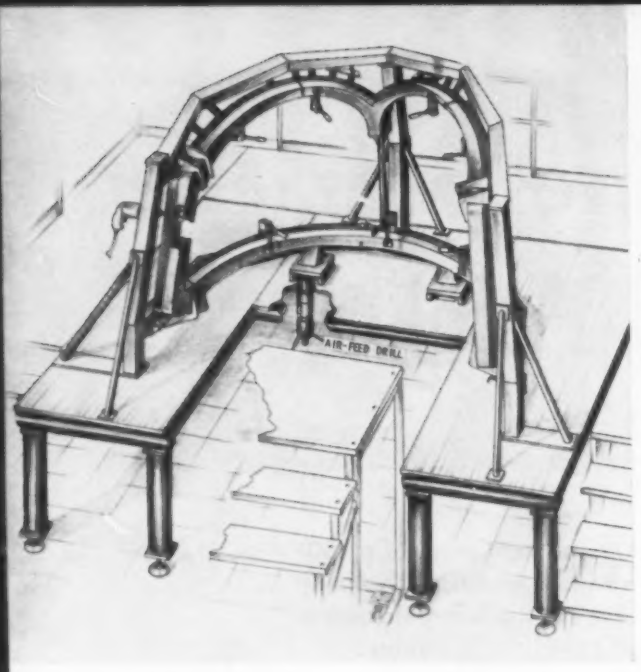


**Fig. 2. First-position canopy assembly and drill fixture. Aluminum banking sections are cast undersize, then surfaced with Kish using the master model canopy as a molding surface.**

After casting, the segments are secured in their respective positions to the steel frame shown in Fig. 3. The master canopy is then locked up in front of, and facing, the frame, leaving an air gap of approximately 1/4 inch between it and the cast fixture members. Either masking or cloth tape is used to dam up the open edges so as to form a cavity or mold.

Kish is poured into this space between the fixture castings and the master canopy. It bonds to the cast-aluminum segments, (lock holes have been provided), but not to the master canopy, which had been coated with a parting compound. When the master canopy is removed, a fixture surface bearing accurate contours and bushed holes for glass attachment, remains.

The Kish used to surface the fixture segments is an aluminum-filled epoxy casting resin that liberates little heat while curing, thereby making it suitable for casting in thicknesses up to 1 1/2 inches. Due to the low curing temperature, a minimum amount of shrinkage occurs during the curing period—on the order of 0.0004 inch per 1/4 inch thickness.

When mixing prior to casting, seven parts of the catalytic agent are added to one hundred parts of the resin. Thorough blending is essential to assure uniform curing. The resin, prior to mixing, is a dark-gray, viscous liquid; the catalyst is amber-colored and of lower viscosity. After mixing of the resin and catalyst, polymerization takes place in approximately twenty-five minutes at a temperature of 75 degrees F. The mass can be handled at this time, although curing is not completed for forty-eight hours.

### *Constant Air Temperature During Canopy Assembly*

Mounting holes are provided around the edges of the transparent panels by the fabricator. Mating holes, however, must be drilled in the canopy frame after it has been assembled. To be sure of an accurate fit between the aluminum frame and the Plexiglas panels, assembly is carried out in a temperature-controlled room, Fig. 3.

The first-position fixture doubles as a drill jig, having a series of bushed holes around its periphery. A portable electric tool is used to drill

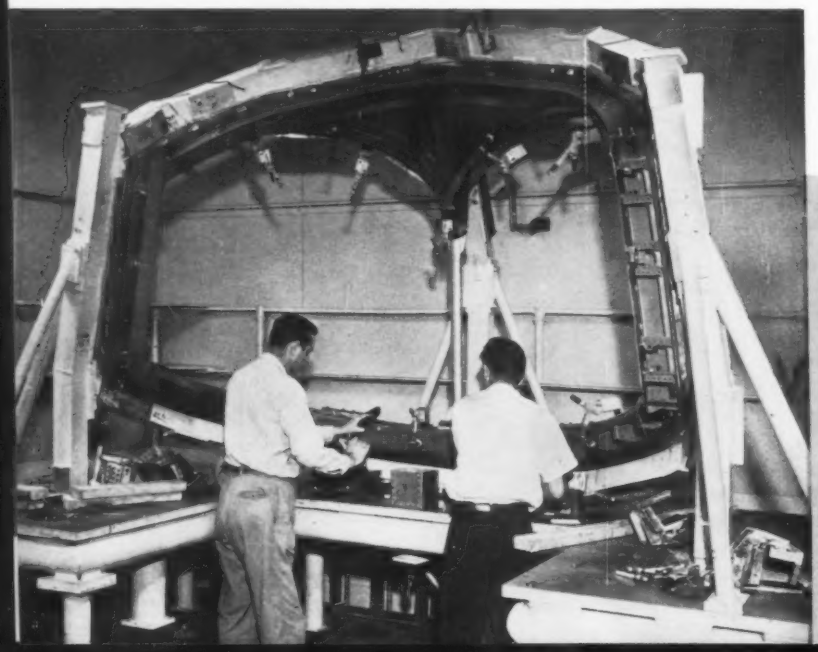

**Fig. 3. Here, on first-position fixture, the canopy frame begins to take shape. Drilling and assembly are done in a temperature-controlled room to assure accurate fit between the hot-stretched Plexiglas panels and the frame.**

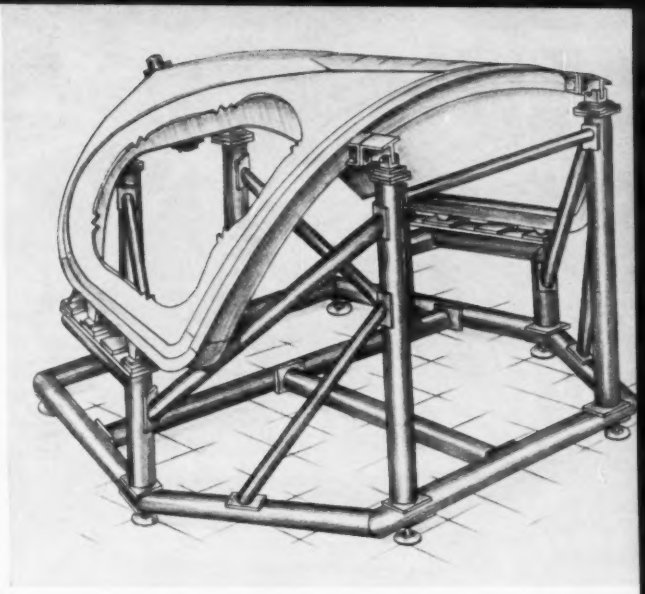

**Fig. 4. Second-position fixture is also located in a temperature-controlled room. At this point, fittings and seals are added to the canopy frame and the transparent panels are installed.**

1/4- and 5/16-inch diameter holes for glass and retainer attachment. Two drill stations are permanently located on the fixture base to drill 39/64 (0.6094)-inch diameter holes which are reamed to 0.625 to 0.630 inch diameter for mounting hinge fittings. The units are air-feed drills (cut-away area, Fig. 2).

Hinge and actuator fittings are among the items assembled in the second-position fixture, Fig. 4. Also, all holes are deburred, and anchor nuts are riveted in place for securing the transparent panels. This partially completed canopy is then removed from the fixture, given prime and finish paint coats, and returned to the same fixture.

During this second phase, the surfaces that are to receive seals are cleaned, cement is applied, and the seals are installed. Following this, the painted retainers are removed, the Plexiglas panels inserted, and the retainers replaced. Slotted bushings are used in the mounting holes in these panels. This is to permit "breathing" of the canopy, or slight shifting of the transparent panels, under temperature and pressure changes.

Much of the operational activity of the Sea-Master will take place at altitudes necessitating cabin pressurization. It can be seen that the canopy, being such a large movable section, presents a sealing problem. Therefore, the third-position fixture, Fig. 5, is designed to pressure-test each canopy.

The fixture is constructed to simulate the pilot's enclosure. Each canopy to be tested is lowered in place over the fixture and clamped in position by the same fittings that will be used to secure it in the aircraft. A safety net is then lowered over the canopy.

Test personnel enter the fixture through an access door. When the door is closed and locked, it is made airtight by inflating a seal.

Pressure is increased within the fixture until a reading of 6.3 psig is reached (relief valve is set at 6.5 psig). Both pressurization and depressurization are carried out at a rate no greater than an equivalent climb or descent of 500 fpm. Personnel inside the fixture are in constant communication with those on the outside. Should the communication system break down, depressurization of the chamber would begin immediately—but at the rate of 500 fpm.

When the test pressure has been reached, the pressurization unit is stopped. For the canopy to

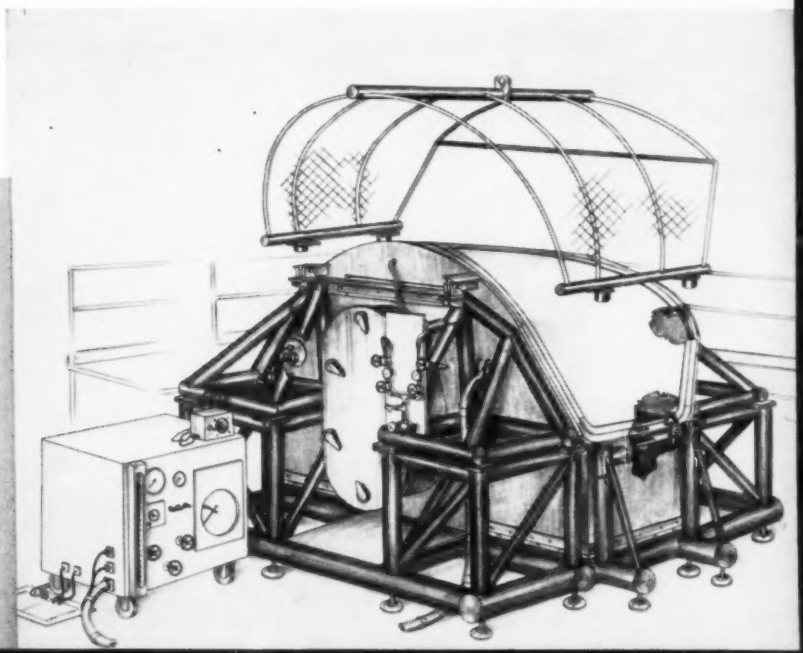

**Fig. 5. Third-position fixture is designed to simulate the pilot's enclosure for the purpose of pressure-testing the completed canopy. A safety net surrounds the canopy during the test. Air leaks are checked from inside fixture.**

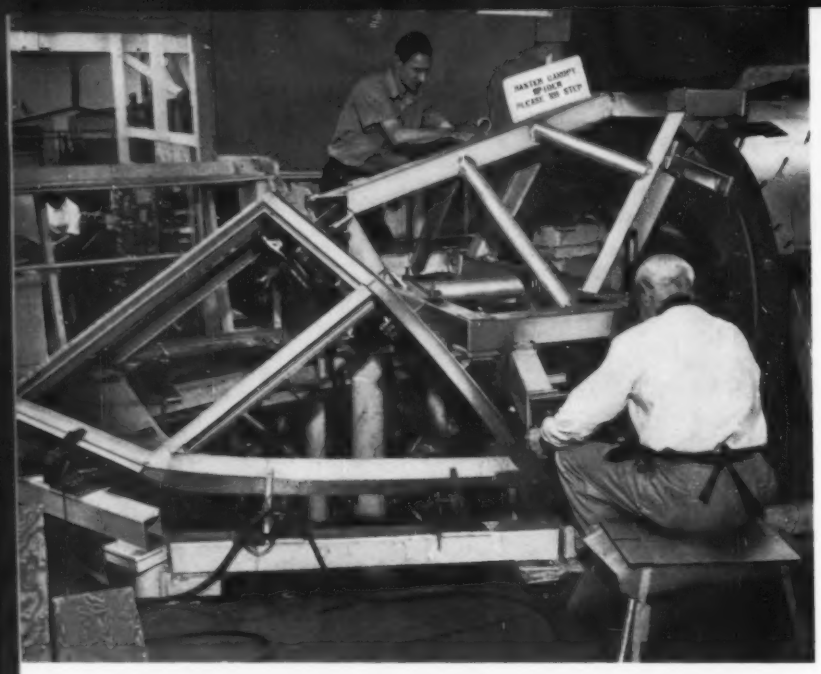

Fig. 6. First-position assembly fixture for the pilot's enclosure. A spider, coordinated to the master canopy, serves to space out the enclosure members until the canopy is added.

check out satisfactorily, the gage should read not less than 4.6 psig at the end of a one-minute waiting period. If the pressure drop is found to be excessive, the leak is located from the inside with a stethoscope and is sealed.

While the canopy is being fabricated and tested, the pilot's enclosure is being assembled on another line. Here, again, the master model canopy (Fig. 1) plays a big role. From this master tool a spider is constructed, bearing all the critical engagement points to be found on the canopy assembly. This is used in place of the canopy to space out the enclosure members, as can be seen at the first-position assembly fixture for the pilot's enclosure, Fig. 6. The spider remains in place until the entire forward hull section (insert, heading illustration) is completed. Just prior to pressure-testing and water-testing of the flight-deck area, the spider is removed and the canopy installed.

A sill, or "canoe," fitting forms the lower edge on each side of the canopy. This member is a U-shaped, hollow aluminum forging. Both internal and external contour cuts on the sill fitting are made on a Cincinnati Hydro-Tel, as can be seen in Fig. 7.

The master model canopy is used to guide not only the assembly stages but also machining operations. The sill fitting from the master tool is used to coordinate all machining fixtures and also for the machining of the first forging. After passing rigid inspection, this first piece is used as a master shape to direct the cutting of all subsequent fittings of the same hand.

Fig. 7. Canopy sill, a hollow aluminum forging, is being profile-milled. The sill from the master canopy served as the first-piece shape control —the first piece being used as the final master shape thereafter.

# Future Machine Tool Needs of the Aircraft Industry

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Douglas Aircraft Co., Inc., Santa Monica, Calif.

THE NEXT GENERATION of commercial transports will travel twice the speed of the new, giant Douglas DC-8's, or even faster. This poses a whole new series of problems. Not only will we need harder or more heat-resistant materials; we must be prepared with the machining and processing knowledge and equipment to form them. This is where research and development of materials for missile and space vehicles will pay off.

The types of machine tools the aircraft industry will need in the 1960's and 1970's are not available now. In many areas, we do not have the forward thinking that will even get these needed machine tools on the drawing boards.

At the air speeds contemplated, metals, ceramics, and plastics will have to be finished to tolerances that cannot be held economically on present equipment. Certain materials will be too hard to handle with present techniques. Some of the components will be too large to set up on existing equipment. Many of the bigger machines available today will be incapable of holding the delicate gages of future materials without chatter or vibration.

Lathes, the stand-by of machine shops, lost prominence in aircraft manufacture some years ago, but shapes of the future are going to bring them back. But they won't resemble the lathes as we know them today, with their massive cast-iron bases and relatively narrow cross-slides.

The cuts are going to be light and fast. Swings of 80 to 90 inches through a 24-foot long gap may be necessary. The cross-slide might not ride the bed at all, and will have to be of ample proportions to remain rigid even when a grinder assembly is hung on it. The base, and perhaps the headstock and tailstock too, may be weldments. Lathe movements will be tracer-controlled in all directions through 360 degrees.

Spinning lathes will be much in the picture. Machines will have greater swing and increased travel than do current models.

Tracer - controlled contour - grinding, with strokes up to 10 feet and diameters up to 4 feet, is plainly in sight. Since the work will be thin-walled, it will require adequate protection from chatter. Diamond wheels will become mandatory because of the types of materials contemplated.

Tube expanding is becoming an increasingly important manufacturing process, but not as we have always known it. Machines will have to expand tubes 16 feet and more in length to diameters never before required, with size control to 0.010 inch. Here, the big obstacle to overcome will be friction.

Heat-treating equipment for these space components must operate up to 2100 degrees F. Furnaces and quenching tanks must be larger. Douglas has on order a furnace having a work area 72 inches in diameter and 18 feet high, yet our sights are already focused on even larger units.

More tonnage is going to be required in forming extrusions and sheets. Perhaps much of the forming will be done hot. Stretch-wrapping facilities may need larger muscles. There too, heat will be needed.

Some components, because of their shape and thickness, will be difficult to finish in any other manner except by electronic machining. We might hang an electronic assembly on a lathe. An electronic approach may be the only economical way to manufacture leading edges made of tool steel, for example.

Again some form of electronic machining promises to be the most effective way to contour stainless-steel honeycomb. Tracer-controlled, the process will work to any engineering tolerance required without marring or defacing the edges, and without the mess of ice-filled structures.

* * *

## Plastics Take to the Air

Reinforced plastics are being used as components of nose cones and rocket motors for the Vanguard, trim fins for the Regulus, fuel containers for the Sidewinder and Falcon, and booster bodies for the Nike. The Dart anti-tank rocket has twenty-three different parts made of reinforced plastics. The B58 Hustler incorporates over a ton of glass-fiber reinforced plastic to protect the structure by insulating it from frictional heat. In commercial aircraft, these plastic materials are used for seats, ducts, cabin liners, bulkheads, flooring, and switch boxes.

AN AUTOMATIC LOADER positions tubing in a 10 5/8-inch National Acme single-spindle bar machine for the first operation on a cup. Equipped with seven carbide tools, the machine turns, bores, and cuts off the cup from the tubing. Coolant and chips drop through the base of the machine into sluiceways leading to a pit; chips are then recovered by a spiral conveyor. Cones and rollers are also made from the same steel analysis (3.5 per cent nickel, 1.5 per cent chromium, and 0.2 per cent carbon).

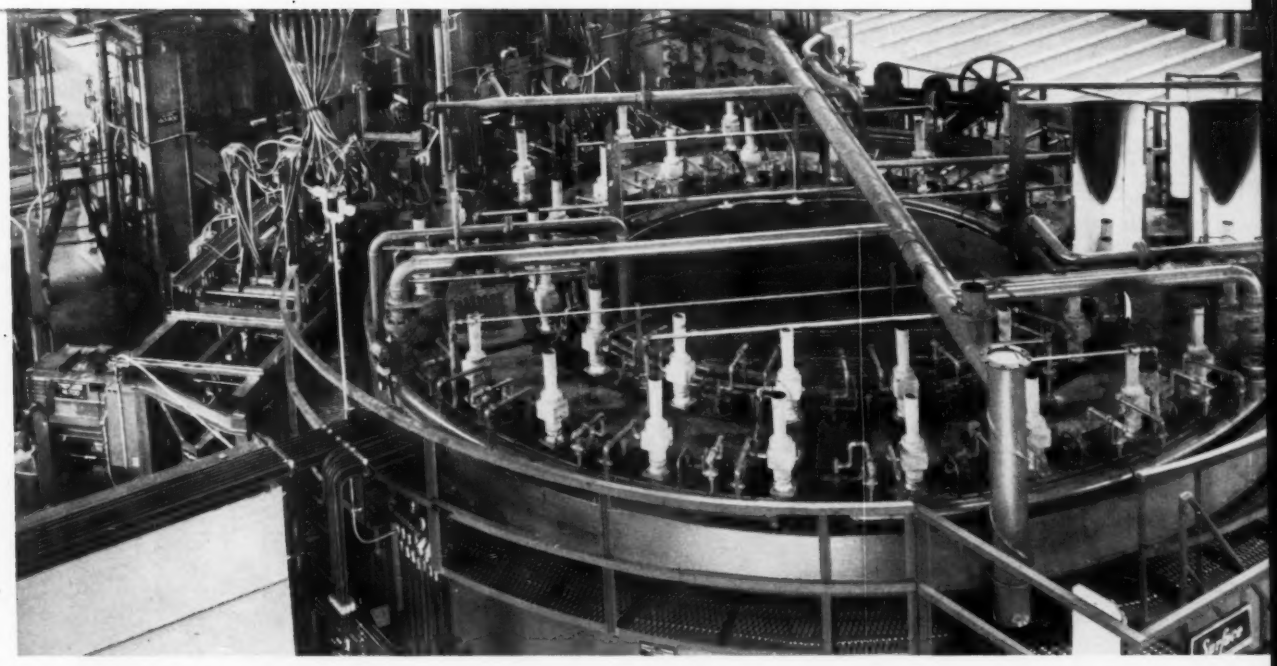
# ROLLER BEARINGS FOR THE NATION'S ROLLING STOCK

THE PERENNIAL PROBLEM of the freight-car hotbox took a long trip toward extinction with the opening this spring of the Timken Roller Bearing Co.'s new railroad bearing production line. Located in Columbus, Ohio, the line can turn out enough bearing sets for 20,000 freight cars a year. Over $7,000,000 have been invested in the facility.

During 1957, according to the Association of American Railroads, freight cars with journals running in conventional brass friction bearings averaged one hotbox every 189,000 miles. This figure reports only those cars that were set out as a result of hotboxes. It is estimated that the actual mileage per overheated bearing was less than 50,000. In contrast, freight cars equipped with tapered roller bearings have been averaging 75,000,000 miles per overheated bearing.

The minimum cost to the railroad for each hotbox is estimated at $150. A serious derailment caused by a hotbox could cost even a million dollars. With roller bearings outperforming the fric-

FOR THE SECOND "green" machining operation, automatic handling devices transfer the cups to this group of 12-inch National Acme single-spindle Chuck-Matics, where the other end of the cup is machined. The cones, one for each end of the cup, undergo similar "green" operations. Next, cups and cones are washed, travel through special marking machines, and are moved on pallets to the heat-treating department. Meanwhile, on a battery of 1-inch National headers, the rollers are sheared and cold-formed at rate of one per second.

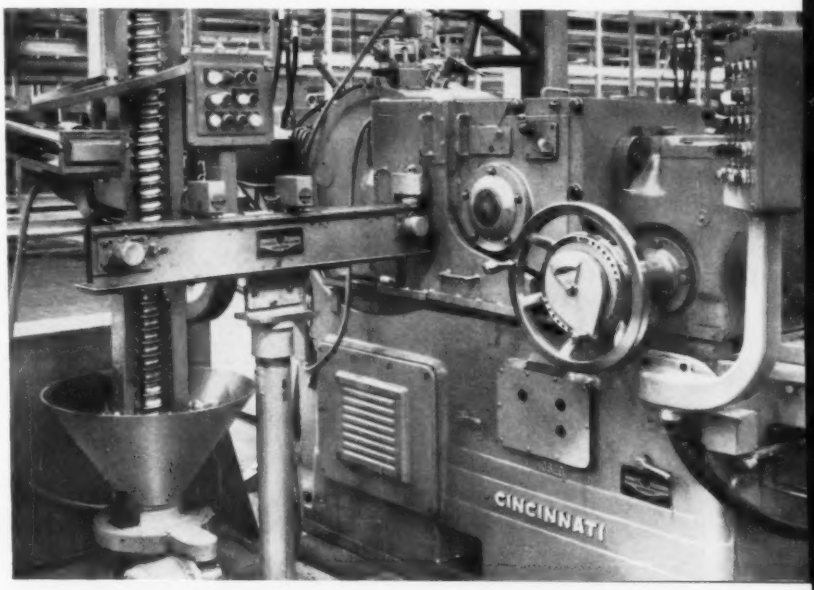


THIS ROTARY FURNACE heats the cups and cones to 1450 degrees F. as they are indexed thirty-nine times between loading and unloading. Hardness is obtained when the work is quenched in the dual-ram presses on the left. A low-temperature draw follows. Previously, the work goes through a twenty-three-hour carburizing cycle at 1700 degrees F., an oil quench, a high-temperature draw at 1100 degrees F., and another oil quench. The heat-treated cups and cones have a case depth of 0.045 to 0.050 inch (depending on size), with a carbon concentration of 0.95 per cent. Rockwell C hardness range for the case is 58 to 62; and for the core, 35 to 45. All furnace operations have controlled atmospheres. The entire heat-treating installation was made by Surface Combustion in conjunction with Timken personnel.

tion bearings 1500 to 1, the hotbox problem can be seen in its true perspective.

Roller bearings offer impressive savings in inspection and maintenance costs. With ordinary friction bearings, an inspection is required at every division point on the railroad. In addition, the freight car receives about 130 separate terminal inspections annually. And to lubricate these bearings, American railroads spend $5,000,000 a year for oil. Roller bearings, on the other hand, require just an occasional touch of the hand to check temperature. They are greased at the factory and can operate over a three-year period without the addition of any lubricant.

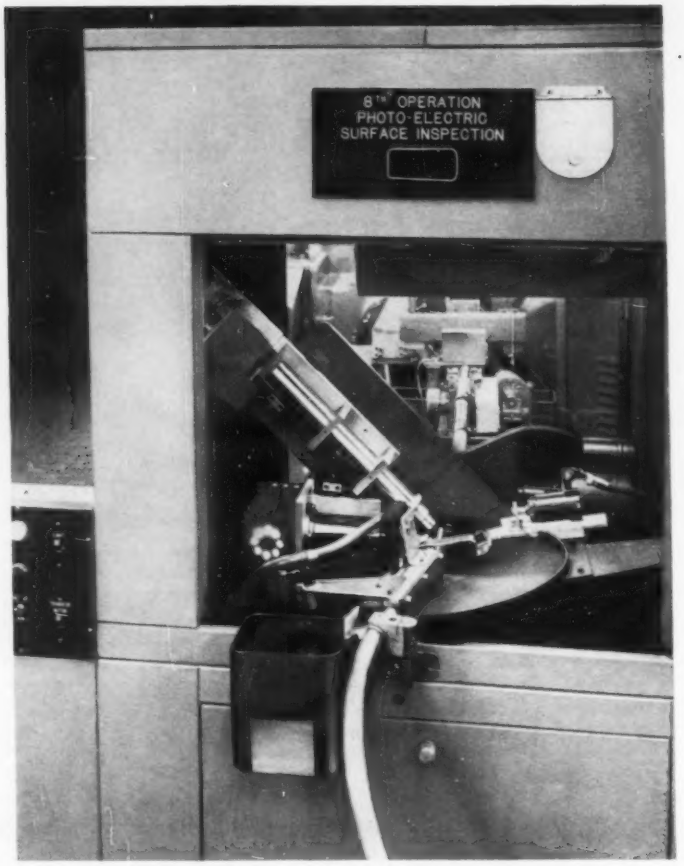
Timken's new line produces a cartridge type unit in five AAR sizes—Class B (4 1/4 by 8 inches) to Class F (6 1/2 by 12 inches). They can be installed as original equipment in new freight cars, or can be interchanged with the friction bearings in existing cars after minor modification of the integral boxes. Shown here are some of the manufacturing highlights.




THIS NO. 3 CINCINNATI centerless grinder is the first of four such machines on the roller-grinding line. The rollers are dumped in quantity into the hopper at left and travel upward along opposite sides of a spiral elevator. They feed through the first machine, then continue through the second, each removing about 0.010 inch of metal from the outside diameter. Automatically shunted to a Gardner grinder, ends are ground flat and parallel. Four Timken-designed machines grind a sphere on the large end, then the third centerless machine removes 0.003 inch of metal, and the fourth, a final 0.0015 inch.

## Roller Bearings for the Nation's Rolling Stock

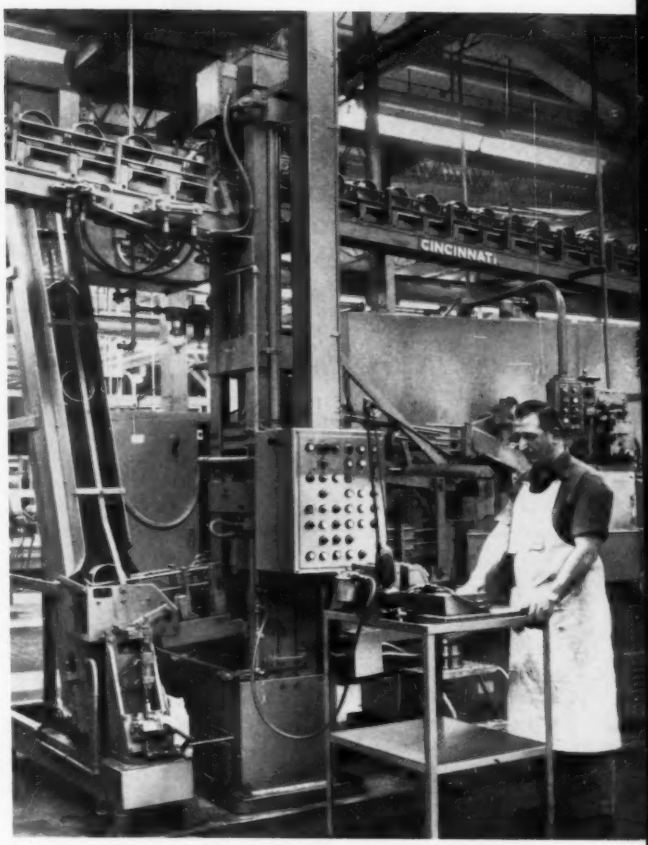
(Continued)




AT A PHOTO-ELECTRIC surface-inspection open cabinet, the ground rollers revolve in a light beam where defects such as nicks or scratches are detected. This unit can inspect forty-eight rollers per minute. Handling is entirely automatic. Next, the rollers are conveyed to a storage machine. There, they enter tubes—enough rollers for one cone per tube—which roll down tracks and are emptied at a cone-assembly machine.

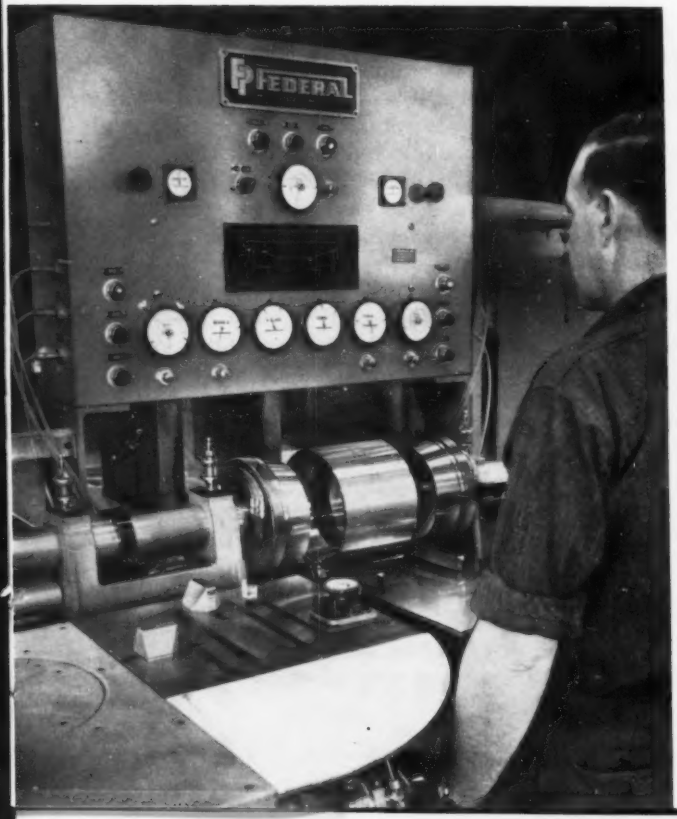
THE LAST of eight machines on the cup-grinding line. This Heald Centri-Matic finish-grinds the second internal race. Cups are transferred automatically from machine to machine by handling equipment which keeps them from contact with each other. Washing stations clean and cool the cups following each grinding operation. The system provides about thirty minutes of storage in the banks between the machines.

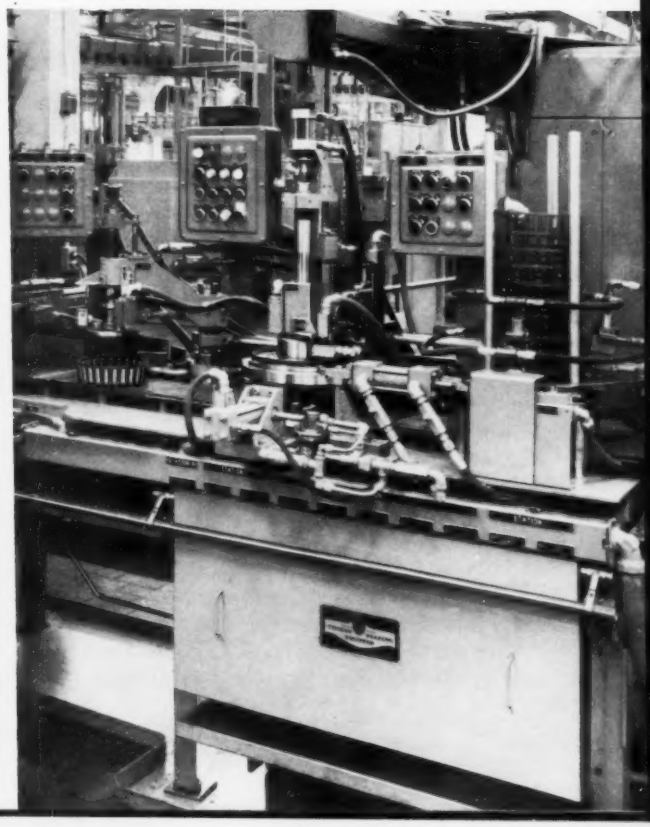
(Right) ON THE CONE-GRINDING LINE, the operator inspects a race after finish-grinding on a Cincinnati Micro-Centric machine. The material-handling elevator for the station can be seen at the left. A monitoring panel and system of overhead lights indicate whether each of the eight machines in the line is operating, is waiting for material, or requires other attention.

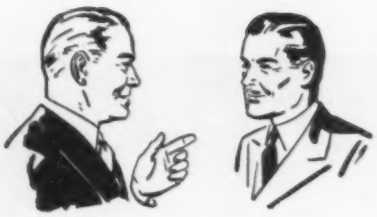



(Below, left) CUPS AND CONES are conveyed from the grinding lines to inspection stations. Each part is examined visually, and final gaging assures dimensional accuracy. Here, a Federal automatic air gage simultaneously checks the stand-out, taper, and counterbore diameters of the two ends of a cup. Accepted parts are then demagnetized, etched with a serial number, and phosphatized against rust.

(Below, right) THIS CONE-ASSEMBLY MACHINE places rollers in the cages, checks that all rollers are in position, places the cone inside the rollers and cage, and closes the entire assembly. It takes less than one minute to complete the cycle. Next, cones are run in under load, and flushed with oil. Cones meet cups at final assembly station later.





# Talking With Sales Managers

By BERNARD LESTER
Management Consulting Engineer

## Strengthen the Sales Front

WHEN BUSINESS takes a nose dive, the selling front becomes critical. Faced with dropping sales, one manager transferred his two market-research men from headquarters to the field to help district sales engineers spot ready prospects. His success in this move demonstrates that it pays to find new ways of fortifying sales power in order to check a disappearing backlog.

Of course, this sales manager needs commercial-research service to furnish guiding facts on industry, territory, and product, but what he needs even more at the moment is help in locating active prospects. The practical type of research program, loaded with urgency to ferret out buyers, can go a long way toward lifting sales efficiency.

Each of the market-research men was temporarily stationed in a key area of maximum business potential. Each was given the job of identifying prospects by using a fine-tooth comb. In the cases of newly uncovered prospects worthy of concentration, the researcher has helped to collect and arrange information needed for a comprehensive sales attack.

Through this type of operation the commercial insight of the researcher is sharpened and his vision broadened by a closer contact with buyers. Such field experience will strengthen his headquarters work later. Also, salesmen get a clearer picture of how to make customer studies.

Another company, whose field sales engineers sell large job-tailored machinery, is using a market-research man to help make individual studies in likely plants. This practice of creative selling, neglected during the recent flush years, is now being revived with good results. Carefully planned selling, using plenty of facts, has now become a reality on each job.

In the case of machinery in great need of improvement and re-styling, a headquarters research man is at work in the field ferreting out underlying customer interests. He works to hasten engineering development and, at the same time, picks up current sales gossip.

One manufacturer of small component parts that in the past had been widely used in industry, had not integrated commercial research with selling. There was nothing to assure him that sales time was spent in the most promising places. Now sorely pressed for business, this company has a research man studying one territory after another and rating customer potential in oder to direct sales effort more efficiently.

The use of market-research men for field work is only one example of the value of temporarily locating some headquarters personnel with field salesmen in times of emergency. Application engineers, estimators, or even sales-promotion men may be logical choices.

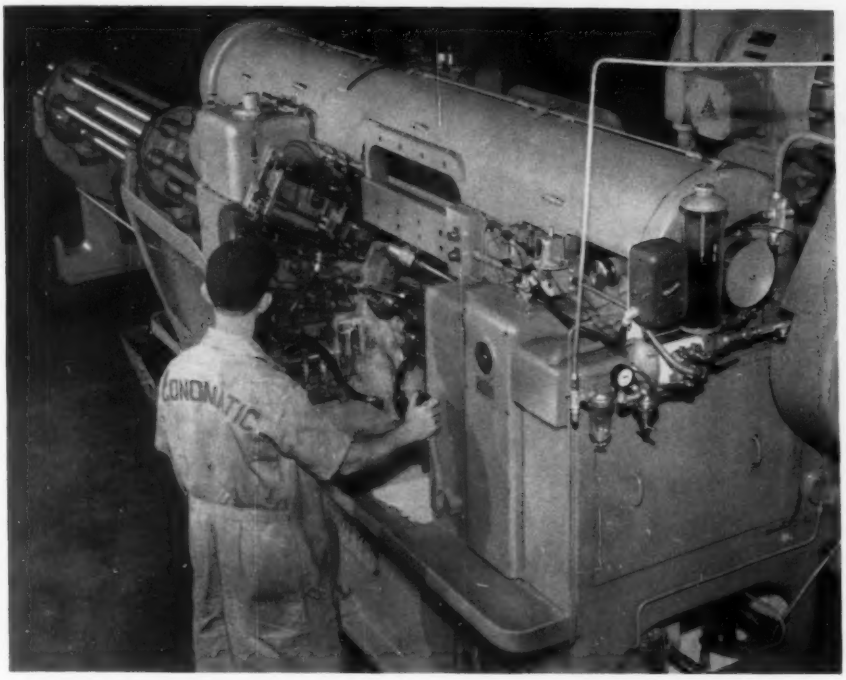
But don't make such moves carelessly. There are several dangers associated with temporary transfers from headquarters to the field.

1. The salesman may attempt to use his new partner as a handyman or sales clerk.
2. Suspicion may arise that the salesman is to be replaced.
3. A false notion may spread that the real purpose of the new man is to make a secret check.
4. Some salesmen will not take time to help the headquarters man get his bearings.

To prevent personality clashes, the men to be moved should be selected carefully. A man grounded only in statistics is out of place in a sales office. Headquarters personnel to be moved should have an interest in technical matters, and familiarity with the equipment sold.

Explain both the urgency and the purpose of the transfer to all concerned. Point out the new relationships and responsibilities, and how each salesman may benefit. Above all, keep a check on each temporary transfer to prevent friction.

Perhaps too many of us are inclined to hold commercial research at arm's length and measure results only from facts gathered and figures assembled. Surely, those who collect and evaluate the information are helped by getting first-hand knowledge of the use to which their efforts are put. Beyond the benefits to the researcher and to the salesman from working together, there is evidence that, in many cases, such a move will yield orders in the current depressed market.




# Getting the Most from Your Multiple-Spindle Bar Automatic

**Cooperative research by the suppliers of machines, bar stock, cutting tools, measuring equipment, and coolants is pointing the way to improved machining practices and lower costs.**

OPTIMUM PERFORMANCE of any multiple-spindle bar automatic depends on the uniformly high quality and coordination of six basic factors: the bar stock, cutting tools and holders, measurement-control equipment, coolant and lubrication, the machine, and the suppliers and operators of this equipment. To coordinate these factors for the purpose of developing improved machine practices and lower production costs, a cooperative, non-profit, research project has been undertaken by a group of suppliers on a permanent basis.

Work-pieces representative of large-volume industrial requirements, and made from popular grades of steel with commonly used tool combinations, will be selected by the group for analysis and simulated production runs. A complete cost breakdown of all of the related items will be made. Parts produced will be stamped, where practical, with the insignia "Comapro" (COoperative MAchining PROject), and used as samples or returned to the steel mills with the chips. The first component being tested is a spark-plug shell.

For this project, the Cone Automatic Machine Co., Windsor, Vt., has set up an enclosed Comapro Department in one wing of its plant, and provided a six-spindle, 1 5/8-inch capacity, "Conomatic" bar machine and operating personnel. This machine is seen in the heading illustration. Associated equipment supplied by the other sponsors and installed in this department includes a Jones & Lamson 30-inch screen, optical comparator, Fig. 1; Federal Products adjustable, mechanical gages; a Rockwell hardness tester; a Brush Electronics Co. Surfindicator; a Black Diamond drill grinder; Blake tap chamfer and flute grinders; and a Royal Oak universal, form-relieving tool grinder. A horizontal-spindle sur-

Fig. 1. Optical comparator having a 30-inch diameter screen is equipped with chart to inspect contours of spark-plug shells and cutting tools.

face grinder being supplied by the Abrasive Machine Tool Co. has not yet been installed.

Of major importance in obtaining optimum machining conditions is the use of high-quality bar stock and cutting tools. Bar stock being used in Comapro research is sponsored by Jones & Laughlin Steel Corporation and Joseph T. Ryerson & Son, Inc. Spark-plug shells are being made from J & L Type A, leaded-steel bar stock. The second component to be analyzed is a bushing made from Ryerson 8630 leaded steel.

Initial tests are being made with high-speed steel tools because of their prevalent use on multiple-spindle bar automatics, particularly for the high-volume, less-complicated work-pieces being considered for the project. However, since the ultimate objective is to develop low-cost production methods, cast-alloy and carbide tools, or a combination of both with high-speed steel, will be used whenever their need is indicated.

Firth Sterling is sponsoring the high-speed steel, cast-alloy, and carbide materials for the forming, cutting-off, facing, turning, shaving, recessing, and trepanning tools. Ground thread taps are supplied by John Bath Co.; twist drills, counterbores, and reamers by the Cleveland Twist Drill Co.; and self-opening die-heads and hollow mills by the Thread Tool Divison of Jones & Lamson Machine Co.

Effective control of the cutting tools is accomplished with a "Toolitrol" board, Fig. 2, supplied by Scully-Jones & Co. This tool control board, which is electrically connected to the multiple-spindle automatic, provides a convenient method of pre-setting and storing sharpened tools, and stops the machine when the tools should be changed. Gages are provided for setting the sharpened tools to the required lengths in quick-change type holders. Counter switches, mounted behind locked panels on the board, are pre-set to automatically stop the machine after a predetermined number of parts have been produced. The machine cannot be restarted until the panels have been unlocked and the counter switches reset.

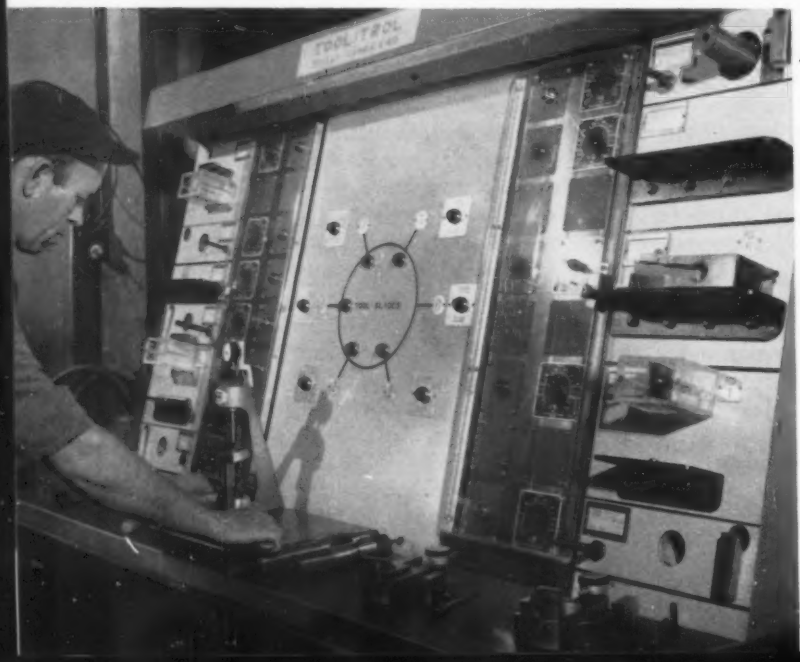



Fig. 2. "Toolitrol" board is equipped with gages for pre-setting sharpened tools, and is electrically connected to the machine to stop it when tools need changing.

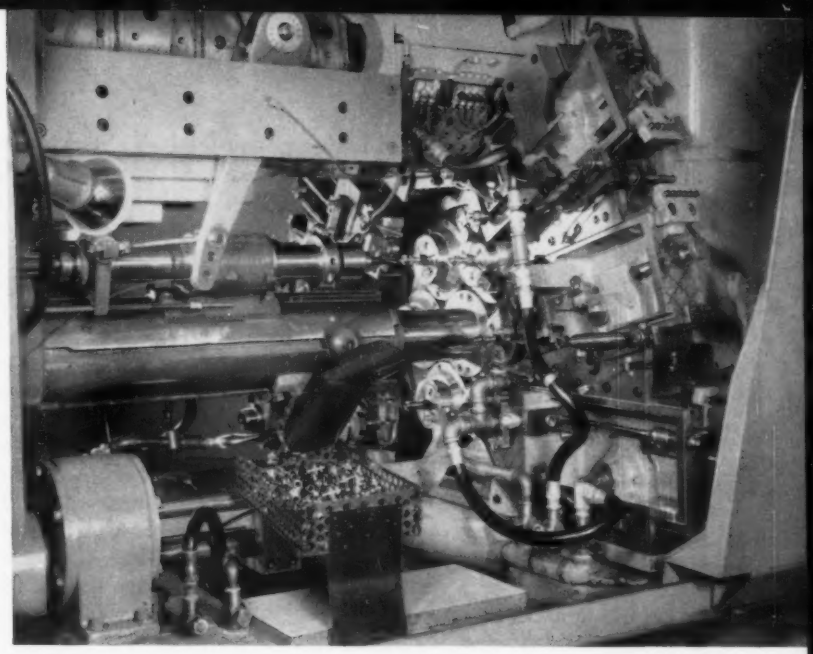


Fig. 3. Tooling area on the six-spindle bar automatic seen in the heading illustration. The machine is set up to complete spark-plug shells in a 4 1/2-second cycle.

The use of pre-set, quick-change holders permits the removal of dull tools without wrenches and their replacement with sharp tools in a fraction of the time necessary with conventional holders. Only 5 minutes and 40 seconds are required to remove and replace nine tools on the spark-plug shell job. With conventional holders, this would require 42 minutes and 35 seconds. Since the cycle time per part, under present prescribed conditions, is only 4 1/2 seconds, the 36 minutes and 55 seconds saved in changing each set of tools represents an increase in production of 492 parts.

Rapid dissipation of heat and fire-resistant features of water-soluble type coolants have made their use popular on automatics that are well sealed to prevent mixing of the coolant with the lubricating oil. Greases, lubricants, and coolants for the Comapro Project are supplied by the Gulf Oil Corporation. For the spark-plug job, "Gulfcut," a heavy-duty soluble oil, is blended in the ratio of one part oil to twenty parts water for use as the coolant. Gulf "Seneca 54" is employed as the lubricating oil for the circulation system, and "Senate 110" for the main end-slide bath lubrication. An electrically timed, central lubrication system, supplied by the Lincoln Engineering Co., is installed on the Conomatic to insure proper maintenance of the machine's slower-moving, functional parts.

Standard equipment on the Conomatic includes master cams with adjustable working strokes for all tool-slides and the bar-stock feed-out. Work-spindle speeds can be varied from 128 to 2502 rpm, with 43 speed changes available. Also, 34 changes of feed rates are possible. The

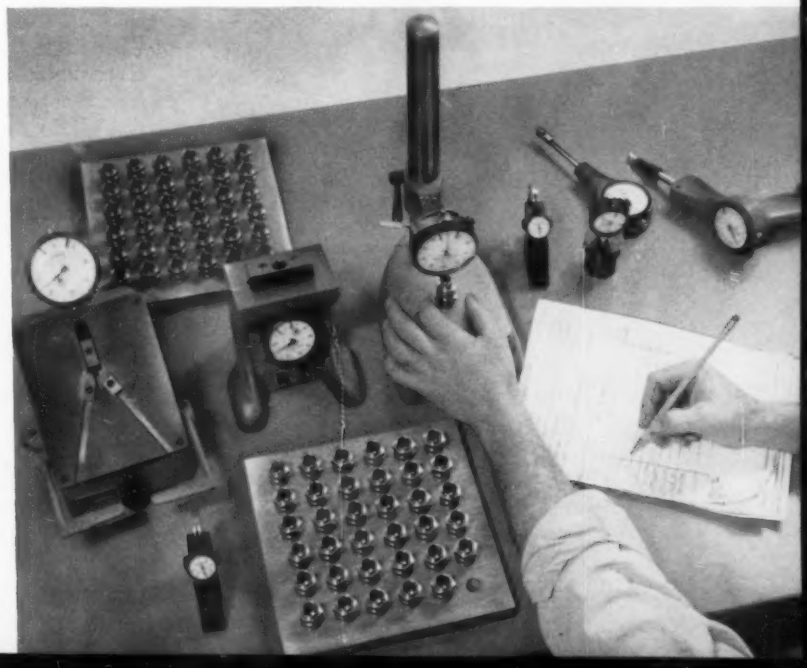


Fig. 4. Group of adjustable, mechanical gages employed to check nine different dimensions on completed spark-plug shell in inspection time of 1 1/2 minutes.

machine is specially equipped with a power-feed knock-off that automatically disengages the feed clutch when the counter switches on the Toolitrol board provide the signal.

A close-up view of the tooling area employed in the production of spark-plug shells is seen in Fig. 3. In the initial setup for producing these parts, the cycle time was 5 1/2 seconds. This was progressively reduced to less than 4 seconds per part, and is now at 4 1/2 seconds, in an attempt to determine the optimum machining conditions. At the first position, a dovetailed form tool is provided on the cross-slide and a 0.527-inch diameter twist drill on the main end-slide. Another form tool is provided on the cross-slide at the second position, and another drill on the end-slide increases the depth of the center hole in the hexagonal bar stock. Knurling of the shell periphery is performed at the third position with a roll attachment mounted on the cross-slide, and a subland drill on the end-slide is fed into the bar. At the fourth position, an attachment is mounted on the cross-slide for shaving, and a 0.328-inch diameter drill is held on the end-slide.

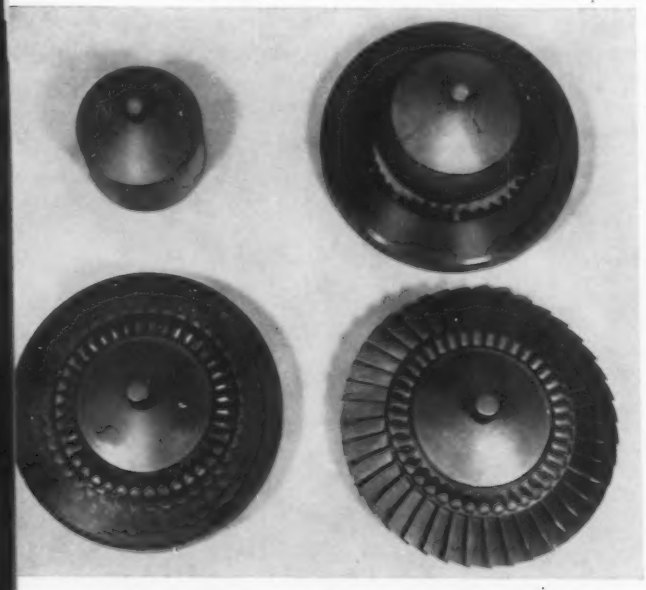
Marking of the spark-plug shell is done with a roll on the cross-slide at the fifth position. An auxiliary, opposed spindle provided at this same position is equipped with a high-speed steel reamer. At the sixth position, the completed shell is cut off from the hexagonal bar stock. Workspindles are rotated at 1440 rpm, providing a cutting speed of 350 surface feet per minute. Feed of the cross-slide tools varies from 0.001 inch per revolution for cutting off, to 0.014 inch per revolution for knurling. Tools on the main end-slide are fed at the rate of 0.0072 inch per revolution, and the reamer on the auxiliary spindle at 0.0115 inch per revolution.

The adjustable, mechanical gages shown in Fig. 4, supplied by Federal Products Corporation, are used to inspect nine different dimensions on the completed spark-plug shells. This check only requires 1 1/2 minutes per part. The Jones & Lamson optical comparator with 30-inch screen (Fig. 1) is provided with a frosted-glass chart, for inspecting the contour of the spark-plug shells and checking the profiles of all the cutting tools at ten times magnification.

# Extruded Hub Retains Turbine Blades

Low-cost turbine and compressor rotors for jet and gas turbine engines have been made by extruding the wheel around the turbine blade roots by a heavy forging press. Developed by the Ford Motor Co.'s engineering research office, the new method eliminates close-tolerance machining of both blade roots and blade-root cavities. These rotors have been produced by Steel Improvement & Forge Co., Cleveland, Ohio, in cooperation with Ford. Calculations show that wheels up to 30 inches in diameter can be produced with a forging press having a capacity of about 30,000 tons.

In the new process, turbine blades are positioned by means of an outside ring and an inner die. Once properly arranged, the space between the blades is filled with liquid Kirksite, an alloy that melts at approximately 700 degrees F. The Kirksite is then allowed to solidify, the inner die is removed, and a hot billet is substituted. A heavy forging press extrudes this billet around the blade roots after which the wheel is essentially complete. Only minor machining is necessary to remove excess metal from the wheel faces. The metals not only retained the properties they exhibited before the hot extrusion process but in some instances actually showed improvements. The airfoil blades are left in their original cast or forged shape at the root end. Four stages of the process are illustrated.



**Billet (top left) is heated and extruded around blade roots to form the wheel hub. Blades are first sealed in Kirksite (top right) after having been positioned. Completed wheel is seen before (bottom left) and after (bottom right) Kirksite is removed from between the airfoil blades. Excess metal is removed by machining.**

# Machine Tool Hydraulics Discussed at Forum

REPRESENTATIVES of machine tool builders and users, hydraulic accessory suppliers, and Vickers engineering and service personnel gathered at the Third Production Machine Tool Hydraulic Forum held recently in Detroit, Mich., to discuss improvements in hydraulic products, system designs, and maintenance methods. The Forum was sponsored by the Machinery Hydraulics Division of Vickers Incorporated, Detroit, Mich.

Co-moderators for the audience-participation Forum were Kurt O. Tech, engineering vice-president of The Cross Co.; and J. R. Cypher, plant manager, Kokomo Torque-Flite Plant, Chrysler Corporation. Keynote speaker was A. V. Bodine, president of the Bodine Corporation and the National Machine Tool Builders' Association. In his talk entitled "Taxes, Tariffs, and Trouble," Mr. Bodine expressed the belief that the hesitation of firms in replacing obsolete machinery with new high-productive equipment is one factor prolonging the recession. He recommended scrapping of the outmoded depreciation policies embodied in Treasury Department Bulletin F; the establishment of tariffs or quotas for machine tool imports on a more equitable, reciprocal arrangement; and an accelerated advance of technology.

A prepared technical paper, "Slow Feed Rate Control," was presented by Glea Hyland, hydraulic engineer of the Sundstrand Machine Tool Co. Mr. Hyland summarized the necessary requirements for a slow feed rate system as follows: holding the internal-system leakage to a minimum, maintaining control of oil metering out of the force device, careful selection of valves and other components with respect to performance, assembling the circuit to maintain firm control of the oil, and keeping friction of all sliding members to a minimum.

During a panel session devoted to a discussion of electro-hydraulic controls, Robert K. Sedgwick, assistant chief engineer, Servo Machine Tool Division, Kearney & Trecker Corporation, read a paper entitled "The Electro-Hydraulic Servo Valve as a User Sees It." Mr. Sedgwick described the favorable results obtained in the application of electro-hydraulic servo valves, hydraulic motors, recirculating ball screws, and tape readers to milling machines.

Other papers presented during this panel session were: "Programming Methods for Automated Machinery," by Joseph Crabtree, director of application engineering, Univac Tab Division, Remington Rand Corporation; and "Electro-Hydraulic Design for Easy Maintenance," by B. K. Ledgerwood, editor of *Control Engineering*. Guest speaker at the Forum dinner was Burnham Finney, editor of *American Machinist*, who discussed "What's Ahead in Metalworking."

"How Planned Preventive Maintenance Can Solve Many Hydraulic System Problems" was the title of a paper given by George C. Bonnell, service manager, Machinery Hydraulics Division, Vickers Incorporated. Mr. Bonnell stated that industry was spending upwards of 11 billion dollars a year for maintenance, and that it is estimated that approximately 22 billion a year will be spent in 1965. He outlined how such costs could be reduced by a well-planned and closely followed program of preventive maintenance. Mr. J. J. Yates, of the Detroit Diesel Division of General Motors Corporation, contributed to the discussion by describing effective preventive procedures his company has had in operation since 1951.

During that portion of the Forum agenda concerned with pumps, it was pointed out that vane type variable-volume, pressure-compensated pumps would produce faster response from "deadhead" condition to full volume displacement than piston type pumps. Under the subject of fluid motors, mention was made that piston type fluid motors rated first, gear motors second, and vane type third, from the viewpoint of power efficiencies. From the standpoint of applying constant-torque loading with minimum pulsation, the piston type fluid motor is preferred, vane motors are second choice, and gear types third.

Considerable difference of opinion was expressed as to the most desirable type of tube fitting. Several attendees stated that their firms used only flareless type fittings, while others preferred the 37-degree, flare type. It was emphasized that proper installation and sufficient support were essential when using either type. Among the suggestions for reducing shock, vibration, and leakage were the use of high-pressure flexible hose and Micarta or wood supports.

During a spirited discussion on the usage of straight-thread fittings, several machine tool builders stated that there had been little demand for this type of fitting, probably due to increased cost. Several users reported on good results with nylon tubing for low and medium pressures.

On the subject of circuits and systems, it was pointed out that air in the hydraulic lines is one of the main causes of "jumping" feeds on hydraulically operated machines. Means should be provided for easy venting of the cylinders. Other possible causes of jumping feeds are improperly lubricated ways, or loose mechanical connections.

This new electrochemical equipment permits a more thorough study of the behavior of stainless steels, for the purpose of gathering background information that will aid in the development of new and improved alloys.

# New Corrosion Research Laboratory Opened

The Carpenter Steel Co., Reading, Pa., has opened a new corrosion research laboratory that introduces important means of accurately determining the corrosion rate on all metals. The new facility enables the company to predict more precisely the area of usefulness of stainless and other corrosion-resisting steels. In addition, it permits thorough examination of titanium, zircalloy, zirconium, and nickel-base alloys.

A twofold purpose is served by the company's expanded corrosion research program: to develop specific information on the performance and characteristics of metals, so that users can make the optimum selection of materials; and to perform studies leading to the improvement of existing, and development of new, corrosion-resistant alloys.

With the new test equipment, alloys can be compared under nearly any process condition encountered today. The laboratory is equipped to work from room temperature to 1000 degrees F., and from a vacuum of one-half atmosphere to a pressure of 2000 psi, with suitable controls to maintain constant exposure conditions.

Special equipment also permits test results to be obtained faster than was previously possible. For example, an instrument known as a "Corrosometer" measures corrosion rates in periods ranging from twenty-four to forty-eight hours. Similar results, obtained by usual methods, would take from two to six weeks. New electrochemical testing equipment makes possible more extensive research into the problems of pitting, intergranular corrosion, and preferential attack on metals.

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## Schoolbell Tolls for Machinery Salesmen

Arrangements are now complete to hold the 1958 Machine Tool Sales Conference at Purdue University, Lafayette, Ind., from July 28 to August 1. Joint sponsors are the National Machine Tool Builders' Association and the American Machine Tool Distributors' Association. The week-long conference, held last year at Cornell, is limited to employes of member companies of the NMTBA or AMTDA. This is interpreted to include representatives of member companies' advertising agencies or other affiliated services.

Harry J. Loberg, Director of Cornell's Sibley School of Mechanical Engineering, heads a twenty-man faculty drawn from industry and colleges and universities. Enrollment blanks and further information can be obtained from Robert H. McGrath, assistant vice-president, National Machine Tool Builders' Association, 2071 E. 102nd St., Cleveland 6, Ohio.

# AGMA Holds Forty-Second Annual Meeting

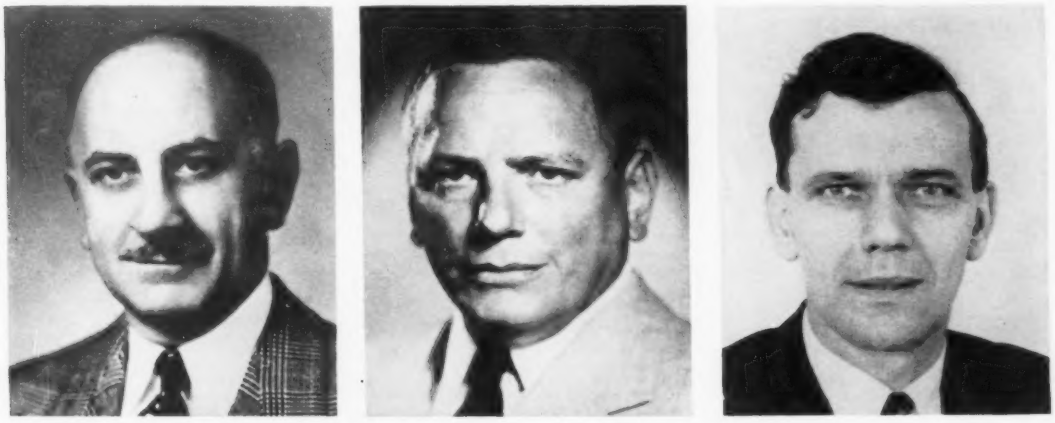
DURING the forty-second annual meeting of the American Gear Manufacturers Association held at the Homestead, Hot Springs, Va., June 1-4, 1958, the following officers were elected: president—E. F. Borisch, executive vice-president, Milwaukee Gear Co., Milwaukee, Wis.; vice-president of the Gear Products Division—John L. Buehler, president, Indiana Gear Works, Inc., Indianapolis, Ind.; vice-president of the Technical Division—Folke Richardz, consulting specialist for gearing products, Westinghouse Electric Corporation, Pittsburgh, Pa.; treasurer—J. F. Murray, president, Winsmith, Inc., Springfield, Erie County, N. Y.

Elected to the five-man board of directors were: George H. Acker, president, Cleveland Worm & Gear Co., Cleveland, Ohio; Richard B. Holmes, general manager, Philadelphia plant, Link-Belt Co., Philadelphia, Pa.; George P. Maurer, assistant chief engineer, Falk Corporation, Milwaukee, Wis.; James H. Robins, president, American Pulley Co., Philadelphia, Pa.; and F. D. Weatherholt, manager, Gearing Division, Westinghouse Electric Corporation, Pittsburgh, Pa.

The American Gear Manufacturers Association's "Edward P. Connell Award" for 1958 was conferred upon Darle W. Dudley, section head of the development section of the Gear Engineering Division, General Electric Co., West Lynn, Mass. The citation on Mr. Dudley's award reads: "In recognition of his many and valuable contributions to the work of AGMA, of his service to the gear industry, and as an authoritative author of gearing literature."

At the general meeting, the re-organization and new bylaws of the Association were explained and discussed. The changes were adopted to better serve the vast and diversified interests of every segment of the gear industry. Under the new setup, the Association will have two vice-presidents instead of one—a vice-president of the Gear Products Division, and one of the Technical Division. Members of the Association will now be designated either a "Company Member" or a "Technical Member," and the terms "Associate Member" or "Affiliate Member" will no longer be used. The title "executive secretary" of the Association has now been changed to "executive director." John C. Sears will continue in this capacity.

"Angular Accuracy of Precision Spur Gears Under No-Load Conditions" was the title of a paper presented by Ferdinand Freudenstein, consultant to the Bell Telephone Laboratories, Whippany, N. J., and associate professor of mechanical engineering, Columbia University, New York City. In his talk, Mr. Freudenstein reported the results of an investigation of the effect on angular accuracy of the various geometrical errors which can occur in a gear under no-load conditions. He defined the term "angular error" as the angular deviation from the correct position of the driven gear in a two-gear train, when



**Newly elected officers of the American Gear Manufacturers Association: (left) president—E. F. Borisch, (center) vice-president of the Gear Products Division—John L. Buehler, (right) vice-president of the Technical Division—Folke Richardz.**

the only error present is a geometrical error in the driving gear and the gears behave as rigid bodies.

Equations were given which represent conservative first approximations due to the simplifying assumptions which were made in the course of the derivations. Errors considered were eccentricity, lateral runout (wobble), profile, pitch, and tooth-thickness variation. Of the geometric errors, the predominant one is eccentricity. To bring gear performance to a higher level, Mr. Freudenstein suggested:

(a) Reduction of eccentricity tolerance from 0.001 to about 0.0001 inch per inch of pitch diameter.
(b) Close specification of lateral runout (perhaps 0.001 inch per inch of pitch diameter).
(c) Use of hobs with larger number of flutes.
(d) Specification and control of permissible slope error in profile test.

Paul J. Leeser, assistant purchasing agent, G&L and Hypro Division, Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., described an in-plant gear education program conducted by his company to develop qualified gear engineers. There have been eleven formal training sessions of the Giddings & Lewis Gear Education Program during the last nine years. The current program offers three somewhat parallel courses, differing in duration and entrance requirements: one course consists of fifty two-hour meetings for men with little training in mathematics; a second offers thirty two-hour meetings for engineering trainees having a minimum background of first-year college mathematics; and the third (now in preparation) will probably provide ten two-hour meetings for design engineers and other professional employes wishing to attend.

Overcoming personal barriers to effective management action was the subject of a talk given by Edward Walther, partner of Management Development Associates, New York City. Mr. Walther described the application of scientific methods and engineering principles to human relations and the solving of industrial problems. Among the barriers to effective management action discussed was that of perception (personal limitations in selecting facts or recognizing important points) and the barrier of language (differences between the language of reports, inferences, and judgments.)

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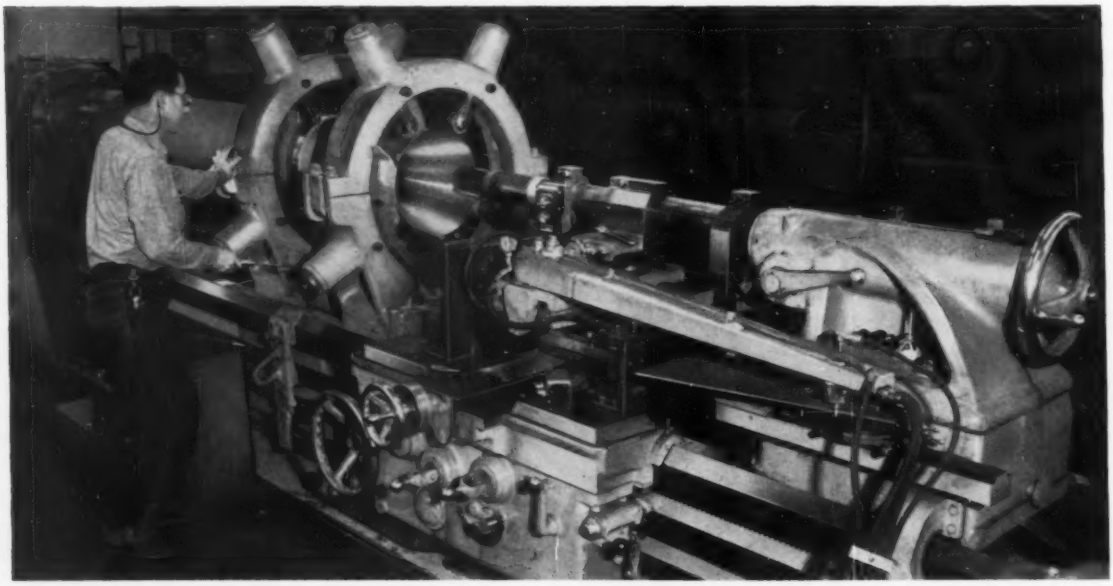
**Final thrust alignment of a rocket-engine case assembly for a Nike anti-aircraft missile is accomplished with tracer-controlled machining at the Goodyear Aircraft Corporation, Akron, Ohio. Each work-piece is a weldment comprising a nozzle made of 4130 steel, the tube, and the forward ring. The assembly must be corrected for any bore distortion caused by welding or heat-treating operations, and receive final alignment for fin attachment rings. This job is performed with carbide tooling on a 44-inch swing, heavy-duty Monarch lathe, equipped with a swiveling Air-Gage Tracer. This tracer, used in combination with the machine's 204-inch bed, permits the entire alignment operation to be completed in a single chucking.**



# Henry Marx Celebrates His Centennial

THE man who is credited with having plotted the progressive path that the G. A. Gray Co., Cincinnati, Ohio, followed through many years, celebrated his one-hundredth birthday on June 22nd, for that was the birth date in 1858 of Henry Marx. He was born in Toledo, Ohio. After attending the public schools of that city, Mr. Marx studied for four years at the Realgymnasium in Karlsruhe, Germany. He graduated in mechanical engineering from Cornell University in 1879.

After his student years, Mr. Marx worked in several shops to get practical experience, including the Straight Line Engine Co., the Gleason Tool Co., and the Bullock Mfg. Co. In 1882 he became associated with the Hill Clarke Co. as a traveling salesman, and until 1889, was manager of their St. Louis branch. In the meantime, Mr. Marx had become interested in the G. A. Gray Co., and in 1889 he moved to Cincinnati to become the general sales manager of that concern.

At that time the Gray plant was located at Sycamore and Webster Sts. Later it was moved to Gest and Depot Sts. and the C. H. & D. Railway, changing to its present location in 1926. In 1905, Mr. Marx had become president of the company and served in that capacity until May 1952, when he became chairman of the board.

Together with Thomas Edison, Ambrose Swasey, and a small group of other engineers, Mr. Marx helped found the American Society of Mechanical Engineers in 1880. This fact was commemorated when the Society presented him with a medal in 1955, at which time he also received a citation in recognition of seventy-five years of service to the Society.

It hardly seems possible that a man who is old enough to have waltzed in Vienna to the strains of the orchestra of Johann Strauss, and who still dimly remembers the sorrow that spread over the country when President Lincoln was assassinated, can still be interested in machine tools. But the machine tool industry remains the hobby of Mr. Marx, and he has kept fully abreast of the revolutionary changes that have taken place in that industry in recent years. His modesty, kindliness, and executive ability have won him the admiration and respect of a host of friends prominent in industry and civic affairs.

**Henry Marx, chairman of the board of the G. A. Gray Co., who has just celebrated his one-hundredth birthday, in conference with his brother Erwin Marx, vice-president; his nephew, Graham E. Marx, vice-president and general manager; and his brother August Marx, president, respectively, reading from left to right.**

# LATEST DEVELOPMENTS

**Machine Tools, unit mechanisms, machine parts and**

## Clearing Hydraulic Press for Bonding Aircraft Structures

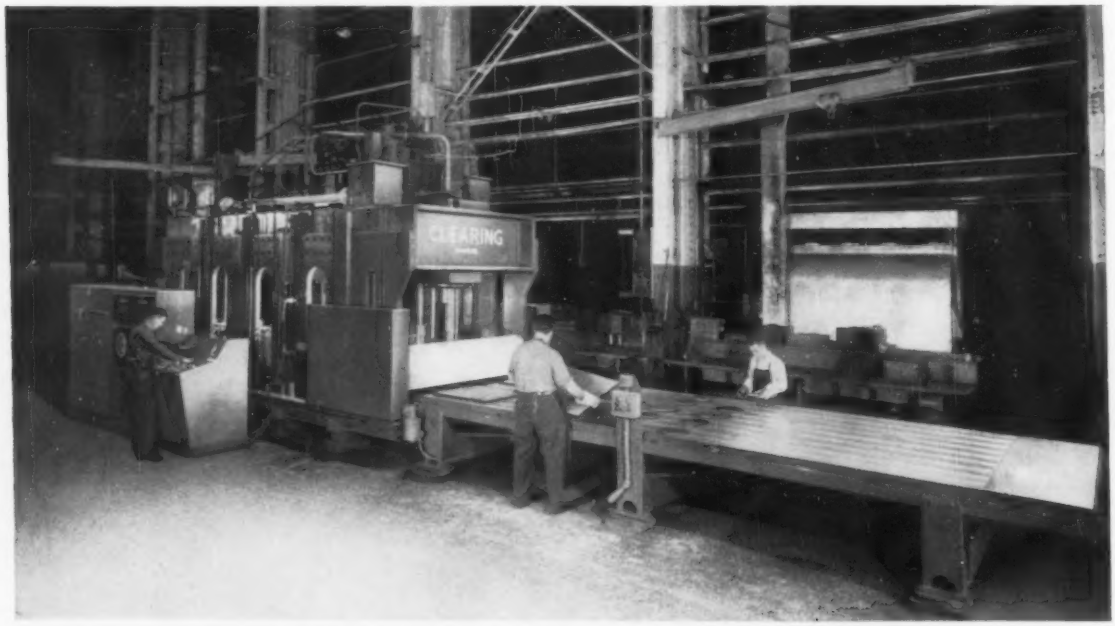
A 1400-ton hydraulic press of special design developed to effect substantial savings in the production of aircraft structural members has been built by the Clearing Machine Corporation Division of U. S. Industries, Inc., Chicago, Ill., and shipped to Convair's plant in San Diego, Calif. The press will be used for bonding a group of similar laminations which have been pre-blanked to the desired shape and size. A number of lamination assemblies are set up on the aluminum tool plate outside of the unit. This tool plate is fixed to a transfer drive. When the assemblies are loaded, the tool plate is power-driven into the press over a series of eccentric type roller bearings. When in position, the eccentrics are rotated, thereby lowering the tool plate onto a hot plate in press bed.

The press slide moves down onto the assemblies and dwells for a predetermined time, then retracts automatically. The tool plate and the now bonded assemblies are then removed, and a similar tool plate, which has been loaded on the opposite side of the press, moves into position for the bonding cycle. All finished bonded assemblies are subjected to a tear test.

The machine is built to specifications that call for unusual accuracy of bed and slide parallelism to make certain that no distortion will appear in the laminated assemblies. The slide and bed are built from solid forgings and a torsion-bar design is used to meet operating requirements. Five cylinder type ram assemblies are used along the center line of the slide on the 18-foot span of the press unit to avoid excess compound deflections. The slide is designed to deflect uniformly with the bed when under pressure.

The press has a hot plate, a cold plate, and an insulating board on the slide and bed. Hot plates are steam-heated to a maximum temperature of 400 degrees F. The water-cooled plate is used to prevent heat transfer to the slide and bed so that high temperatures used in the hot plate cannot affect the accuracy of these parts. The bed area is 216 by 84 inches, the stroke 28 inches and the shut height 0. Power is furnished by a 30-hp motor operating at a speed of 900 rpm. Over-all dimensions are: height, 16 feet; width, 61 feet; and depth, 10 feet. The machine weighs approximately 400,000 pounds.

Circle. Item 101 on postcard, page 197




Bonding aircraft structure on new Clearing hydraulic press

# IN SHOP EQUIPMENT

**material-handling appliances recently introduced**

Edited by FREEMAN C. DUSTON

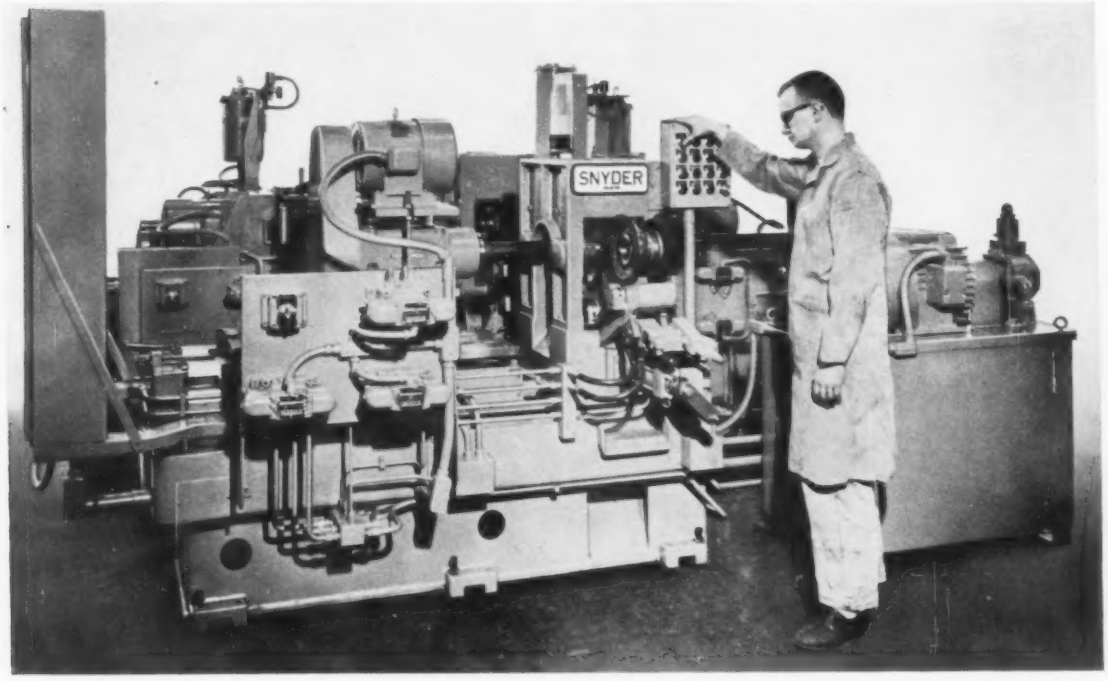
## Snyder Special Combination Machine for Processing Tractor Track Rollers

A special machine incorporating transfer and line-index automation principles for boring, drilling, chamfering and tapping track rollers for crawler type tractors has been designed and built by the Snyder Tool & Engineering Co., Detroit, Mich. The machine is designed to process four different track rollers with a minimum of tool changes. Two of the parts are identical as far as machining is concerned, only boring tool changes being required to switch production from one part to the other. Pot type interchangeable heads are provided for drilling, chamfering and tapping operations on the other pair of parts, which have different bolt cirele diameters and hole spacings. Release finger spacing devices and stops in the transfer mechanism of the machine are also changed for processing the latter two parts.

Essentially, this equipment is a combination of a single-end boring and a line-indexing machine. Parts placed in a gravity type loader roll into the machining position in the boring machine. Finish-bored parts are transferred automatically to a fixture in the line-index machine by a hydraulic cylinder-actuated transfer mechanism. Then the fixture is automatically indexed in sequence to three stations where six holes are drilled, then chamfered, and finally tapped. At the completion of the tapping operation, a finished part rolls out of the fixture, which is returned to its initial position, where it receives another finish-bored part.

The use of the three-station index machine enables a balanced-cycle sequence to be achieved while drilling, tapping and chamfering operations are carried out during the hole-boring operation. The resulting combination machine produces track rollers at a rate of 39 pieces per hour. The machine occupies a floor space approximately 12 by 17 feet. Five Snyder standard way type machining units powered by one hydraulic pump and tank unit perform all the machining operations. These units have hardened and ground ways, automatic lubricating systems, and are mounted on fabricated-steel bases.

Circle Item 102 on postcard, page 197




Snyder machine utilizing principles of automatic transfer and line-index equipment to process four different parts

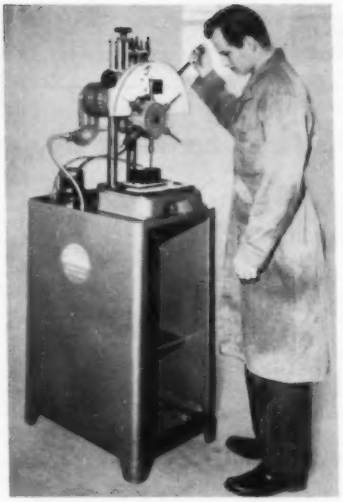
## Transfer Machine Converted from In-Line to V-Type Cylinder-Block Processing

The use of "building-block" type standard milling and drilling units in a transfer machine built by Kearney & Trecker, Milwaukee, Wis., for the production of in-line diesel-engine cylinder blocks greatly simplified the conversion of this machine for processing V-type engine blocks. The cost of conversion on the 125-ton, fifteen-station machine is said to be only half that of the original assembly. The converted machine will accommodate V-6, V-8, or V-12 cylinder blocks of either cast iron or aluminum.

Thirty-one surfaces are machined on each work-piece. Milling operations are performed on the pan rail, bearing-cap seats, top, side pads, banks and ends of the cylinder block, to a consistent 65 micro-inch finish. Holes are drilled and reamed in the pan rail and bearing-cap seats.

In addition to the master control console, each machining station is equipped with an individual control for use during work-piece setup. Positioning slides are provided for the milling heads together with mechanical arms that facilitate cutter changing. Automatic force feed, positive-metered lubrication is employed throughout. In the event of lubrication-system failure, the machine is automatically stopped and the area of trouble is indicated on the control panel. Flood coolant, supplied throughout the machine from a central system, very effectively flushes the chips off the fixtures and down through the chip-removal chutes.

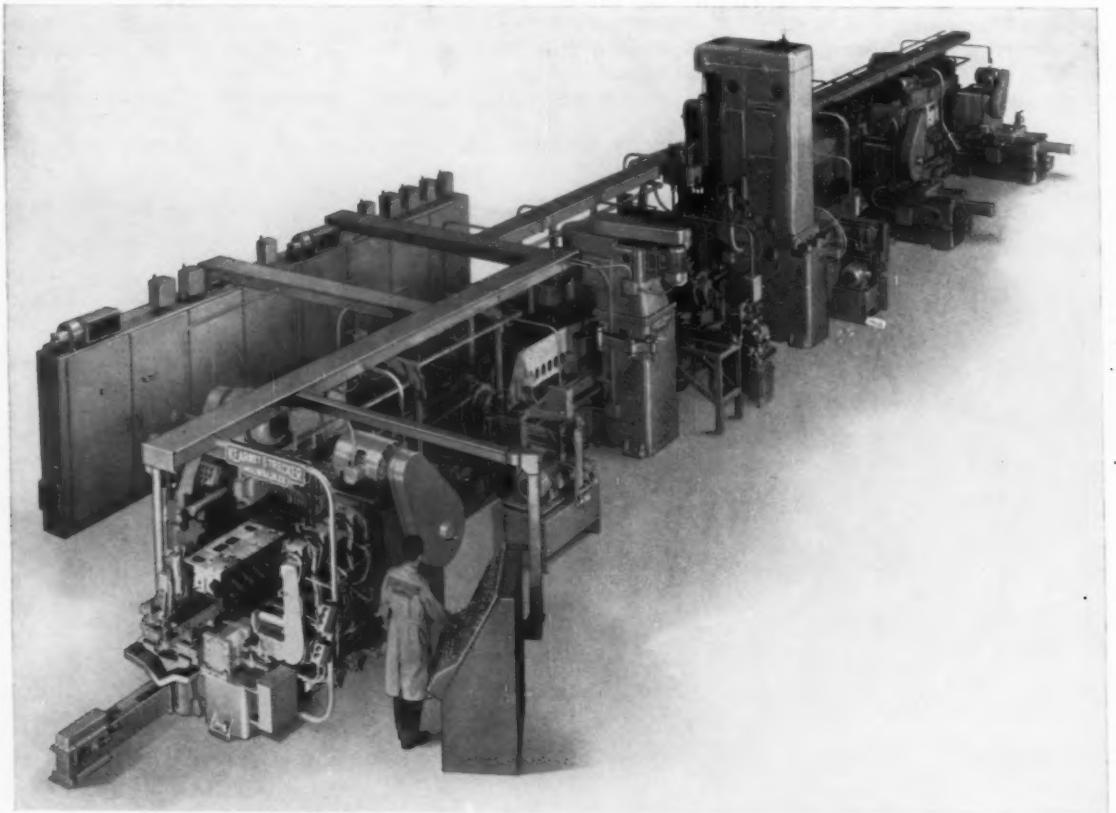
Circle Item 103 on postcard, page 197



Burgmaster floor-model turret drill

## Burgmaster Turret Drill

A six-station turret drill with a capacity for drilling up to 1/4-inch diameter holes in steel has been introduced by the Burgmaster Corporation, Small Tool Division of Burg Tool Mfg. Co., Inc., Gardena, Calif. This machine will drill, tap, counterbore, ream or perform other work up to a



Kearney & Trecker fifteen-station transfer machine converted from in-line to V-type engine-block processing

total of six operations without changing the position of the part. The turret is power indexed automatically when the head reaches its highest position. Each spindle, however, will repeat any number of feed-strokes without indexing, if duplicate operations are desired.

Each spindle operates at its preselected speed within a range of 350 to 6200 rpm. A coolant system consisting of circulating pump and reservoir is enclosed in the base. The machine pedestal requires a floor space 18 by 24 inches and is 36 inches high. Over-all height is 64 1/2 inches.

Circle Item 104 on postcard, page 197

## Form and Punch Shaping Machine

The Jersey Mfg. Co., Elizabeth, N. J., has announced a "K-15" universal form and punch shaping machine equipped to produce contours of all kinds, including surfaces and punches with curved necks. Parts turned to a tolerance of ± 0.00025 inch on this machine have accurate and clean cuts on all worked areas and for most purposes can be considered finished.

Incorporated in this machine are such features as speeds of 50, 75, and 110 strokes per minute; a working area up to 6 by 6 1/4 inches; stroke 0 to 6 inches for punch shaping; maximum length to beginning of radius 4 3/4 inches; electric direct-drive motor 220/440 volts, 60 cycles, 3 phase; and built-in lubrication.

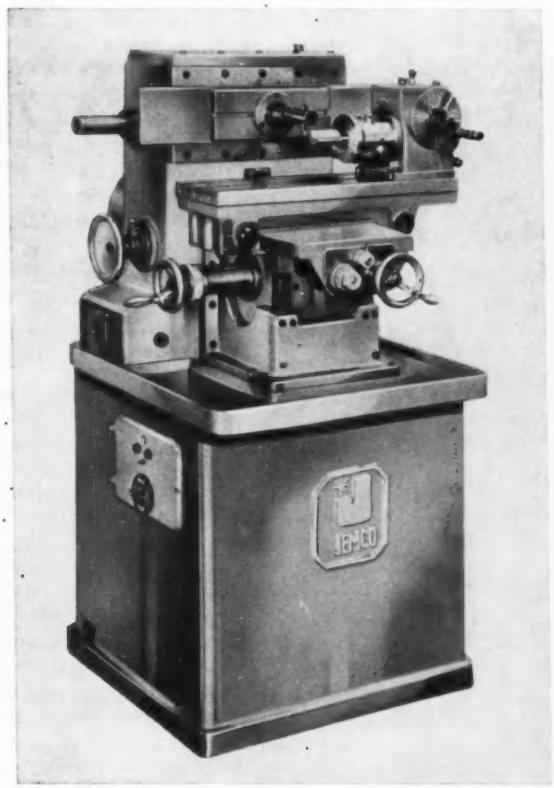
Irregular-shaped stamping and electrode punches of high precision can be produced by this shaper, which employs a large dividing head with automatic circular feed, permitting the automatic machining of radii and angles. Additional attachments and clamping devices permit machining of the entire surface of a work-piece without need for reclamping. The added feature of a special built-in 30-power microscope for extremely high precision punches permits inspection while the part is being machined.

Circle Item 105 on postcard, page 197

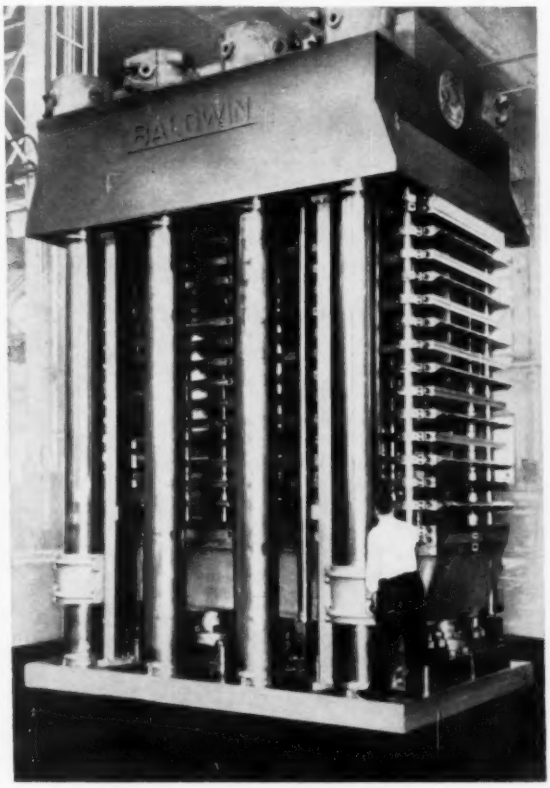
## Baldwin Steam-Platen Hydraulic Press

A 4540 - ton, multiple - cavity steam-platen hydraulic press built by the Hamilton Division of Baldwin-Lima-Hamilton Corporation, Hamilton, Ohio, has been installed by the Formica Corporation at its Evendale, Ohio, plant to meet the demand for its increased laminated plastic production. Layers of paper—waxed, plain, and plastic-impregnated—become hard and durable solid sheets after curing in the press. It incorporates fourteen openings in which a total of 112 sheets—eight per opening—can be cured at one time. In a normal twenty-four-hour day, the press can turn out a total of 2240 sheets. Standard size sheets have dimensions of 4 by 10 feet.

Circle Item 106 on postcard, page 197



Universal form and punch shaping machine announced by the Jersey Mfg. Co.




Baldwin multiple-cavity steam-platen hydraulic press for laminated plastics

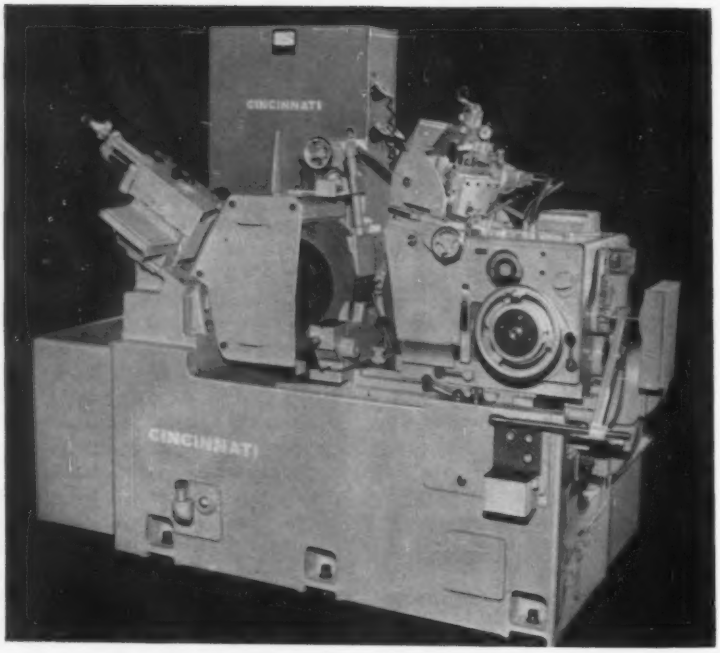



Fig. 1. Cincinnati Filmatic centerless grinding machine

## Cincinnati Filmatic Centerless Grinding Machines

Cincinnati Grinders, Inc., Cincinnati, Ohio, has brought out improved models of the Nos. 2 and 3 machines of its line of centerless grinders. These precision grinding machines, rated at 15 and 25 hp, are of the same general design and have the same newly developed features and accessory equipment. They have the wheel-truing controls located at the left-hand end of the bed as seen in Fig. 1, and the bed is made 5 inches longer to provide better support for the grinding wheel truing units. Greater throat capacity accommodates larger regulating wheels (13 instead of 12 inches in diameter). The infeed lever can be moved through a partial arc for manual feeding, while retaining the advantage of automatic ejection of the work. A parallel slot on the work pad facilitates alignment of the work-rest blade with a dial indicator. New grinding fluid control eliminates splashing and more effectively floods the work.

The wider range of accessory equipment now available includes a vari-pitch unit for hand-infeed grinding. Through a simple change-gear arrangement, Fig. 2, the operator has a choice of three throat openings between the wheels for loading and unloading the work. A precision indicator attachment for rapid, visual, taper correction is also available. This unit, mounted on front of the machine near the swivel adjusting screws, is employed for accurate infeed operations. It incorporates a taper correction calculator, and two dials, one for direction of swivel and the other for amount of correction, measured in increments of 0.000010 inch per inch of length.

Automatic grinding wheel balancing can be obtained as a built-in feature. In addition, a new attachment is available for 3/16-inch forward or back endwise adjustment of the grinding wheel spindle. This unit is equipped with a large indicator dial and handwheel which can be reached from the operating position.

**Circle Item 107 on postcard, page 197**

Fig. 2. Change-gear arrangement on machine shown in Fig. 1.

## Improved Shock-Resistant Tool Steel

The Crucible Steel Company of America, Pittsburgh, Pa., has developed a new tool steel in response to the growing demand in the tool and die industry for a steel having improved shock resistance combined with high toughness at the upper hardness levels. Known as LaBelle HT, the new product is a low-alloy steel developed in the company's research laboratory for applications requiring unusual resistance to shock or impact such as shear blades, impact extrusion tools, cold-heading dies and punches, and coining and striking dies.

**Circle Item 108 on postcard, page 197**

## Lapointe Indexing Machine

An automatic rotary indexing machine designated the "Rotomatic Positioner" is being built in seven table sizes ranging from 24 to 84 inches in diameter by the Lapointe Machine Tool Co., Hudson, Mass. High-speed automatic indexing for any number of divisions from 10 to 2500 is obtained with this machine by means of a simple change-gear system. Accuracy is held within 5 seconds of arc on "A" Series machines and 15 seconds on the "B" Series. Hand indexing can be used for an infinite number of divisions.

The machine is available in either the horizontal or vertical type. A sine base can be furnished for tilting the horizontal table to any desired angle. This equipment is suitable for such shop operations as heavy drilling, milling and boring. It is also adaptable for broaching, and can be used for programming and tracing work. The table will support loads up to 50,000 pounds.

Circle Item 109 on postcard, page 197

"Rotomatic Positioner" built by the Lapointe Machine Tool Co.

## Quenching Press for Gears and Similar Work

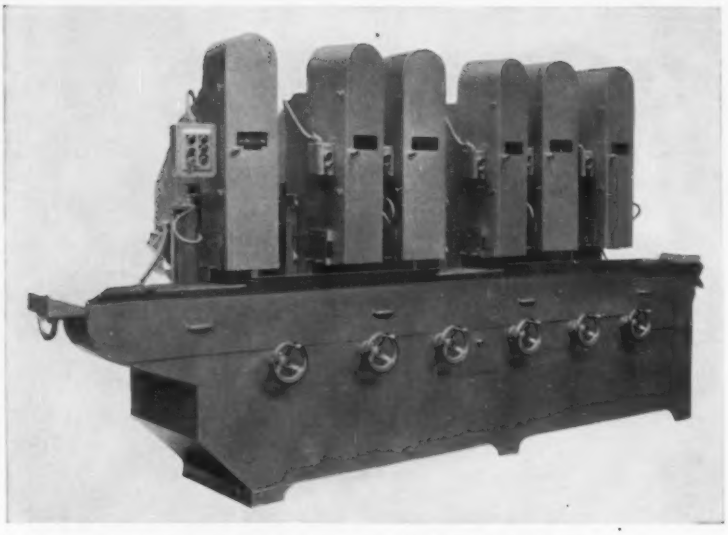
The Gleason Works, Rochester, N. Y., has announced a No. 117 quenching press designed to utilize new methods for handling heated gears and other round, flat and cylindrical parts so that they will be quenched rapidly and without distortion. Work of improved quality is also claimed for this new machine as a result of its ability to remove the parts more quickly from the furnace and its application of a pulsing and flexing cycle—two new concepts in metal quenching.

The work-piece is held between contact rings for the pulsing, flexing and initial quenching operations which are performed during the period when the critical changes occur. These changes are nearly completed when a temperature of about 700 to 900 degrees F. is reached. The work-piece is then loaded onto a conveyor belt that moves slowly around the tank, under the oil, until the part is cooled and reaches the discharge elevator. This allows the clamping mechanism to return to a loading position and immediately receive another work-piece for quenching.

The flexing cycle starts immediately after the contact rings close on the work-piece in the quench chamber. The part is flexed between the upper and lower contact rings with a diaphragm-like action that helps reduce distortion. Then it is quenched by forcing the oil uniformly over and around the part, instead of merely immersing it in the quenching fluid.

Pulsing is the momentary re-

Gleason gear-quenching press incorporating pulsing and flexing cycle



Engelberg conveyor type multiple-head belt grinder

leasing and reapplication of all pressure exerted on the work-piece, by the outer and inner clamping rings and the expander, during the controlled quenching cycle. This allows the work-piece to contract without undue strains. The important pulsing feature is controlled by a built-in valve, operated by pre-set timers.

A metallurgically correct flow of the quenching oil from the 300-gallon-per-minute system is pre-selected to suit the particular job. The quenching press handles ring gears and cylindrical parts up to 8 1/2 inches in height.

Circle Item 110 on postcard, page 197

## Conveyor Type Belt Grinder with Six Adjustable Grinding Heads

A conveyor type abrasive-belt grinding machine that makes possible six grinding operations in a single conveyorized pass of the work has been brought out by the Engelberg Huller Co., Syracuse, N. Y. This Model No. 680-6 grinder is designed for high-volume, flat surfacing of ferrous and non-ferrous metals, glass, plastics, ceramics, and other materials. It is equipped with six individually adjustable grinding heads. By using a series of progressively finer grit abrasive belts, unmachined parts can be rough-ground, precision-sized, and machined to a fine micro-inch finish in one continuous operation.

The machine will handle work-pieces 5 inches high, 5 1/2 inches wide, and of any length. The conveyor belt is 7 inches wide by 268 inches long. Models are also available with 8-, 10-, and 12-inch wide abrasive belts, with corresponding increases in work-piece capacity. Quick, manual adjustment of the conveyor belt speed is obtainable from 2 to 25 feet per minute.

The Model No. 680-6 machine is designed for both wet- and dry-belt grinding. Its self-contained cooling system has two 1/2-hp coolant pumps. Abrasive belt size is 6 by 80 inches, and the abrasive belt speed is 5500 surface feet per minute. The grinding heads are powered with 7 1/2-hp drive units.

Circle Item. 111 on postcard, page 197

## Huge Tube Bender and "Free-Flex" Mandrel Built for Aircraft Work

The Pines Engineering Co., Inc., Aurora, Ill., recently built what is claimed to be the largest tube-bending machine in existence. This hydraulically operated unit, Fig. 1, makes possible the bending of ultra-thin stainless-steel tubing having an outside di-

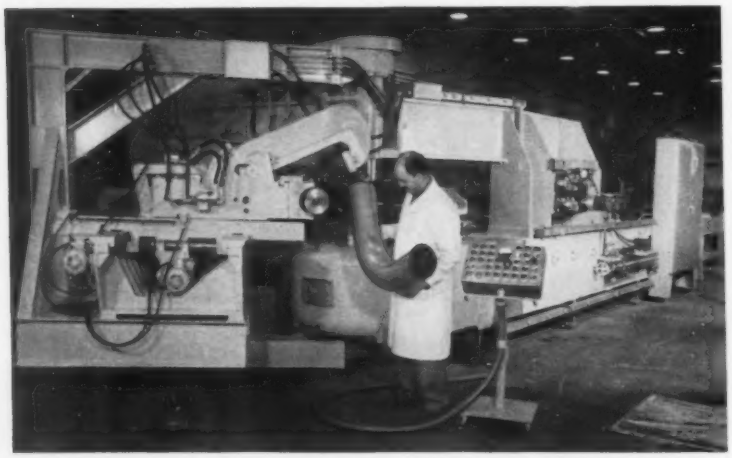


Fig. 1. (Left) Thin-wall aircraft tube bender of giant size built by the Pines Engineering Co., Inc.
Fig. 2. (Right) "Free-Flex" mandrels for bending thin-wall tubing designed by Boeing Airplane Co.

ameter of 8 inches and a wall thickness of 0.020 inch.

Previously, practically all the large tube bends or elbows of this size were made by the half-shell stamping method, the two shells being welded together. The new machine now provides the means for producing large, bent sections of high-quality tube components for air and fuel ducts in jet aircraft.

All tool carriages of the machine are fully motorized, and adjustments are controlled by push-buttons located in the main operating-control stand. Along with the provisions for power adjusting the various tool-carriage members, calibrated dials and gages are provided for all tool settings to indicate position or amount of travel.

"Free-Flex" mandrels of the type shown in Fig. 2 are also being manufactured by the Pines Engineering Co., Inc., under license from the Wichita, Kan., Division of the Boeing Airplane Co. This new flexible ball mandrel is designed for high-quality bending of thin-wall tubing and is available in sizes from 1 to 6 inches in diameter. It is constructed of steel for the bending of non-ferrous and carbon-steel tubing, and Ampco-coated steel or solid Ampco for the bending of stainless-steel tubes.

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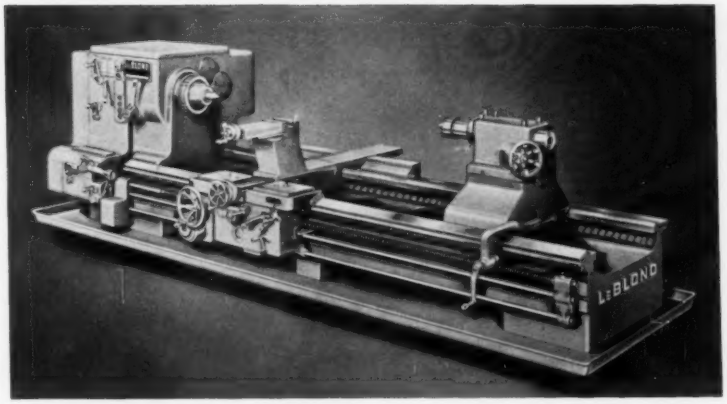



Fig. 1. "General One-75" large-swing lathe brought out by R. K. LeBlond Machine Tool Co.

## Large-Swing Lathes for Turning Missile Bodies

Two large-swing, relatively light-powered lathes were recently announced by The R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. These lathes, with up to 50-hp drives, were brought out in answer to industry's demands for reasonably priced lathes of unusually large swing for use in turning missile bodies and other large, cylindrical, tubular, and fabricated parts.

The models, known as "General One-75", Fig. 1, and "Admiral Two-120," Fig. 2, incorporate new wide-bed designs developed to assure proper absorption of the cutting force by the bed. The "General One-75" incorporates an extra-wide bed and carriage and swings work up to 75 inches in diameter. The "Admiral Two-120" features double-bed construction (two beds integrally cast in parallel) and is currently designed to swing work up to 120 inches in diameter, with center distance as required.

Tracing equipment is available on both machines—Hydra-Trace, two-way duplicating attachment or LeBlond's new 90-degree tracer. These lathes can be adapted both in swing size and power to suit individual needs.

Circle Item 113 on postcard, page 197

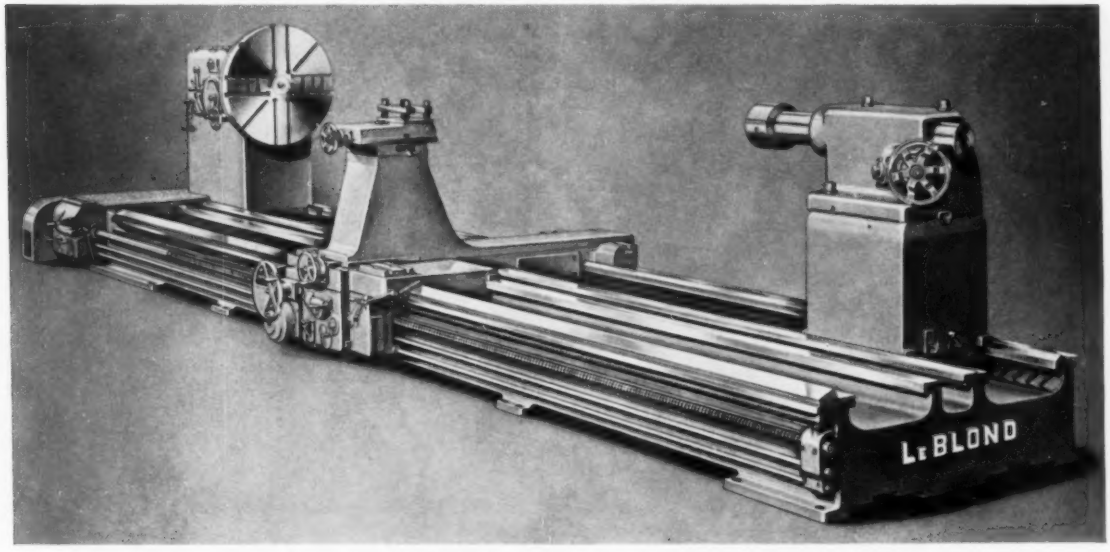
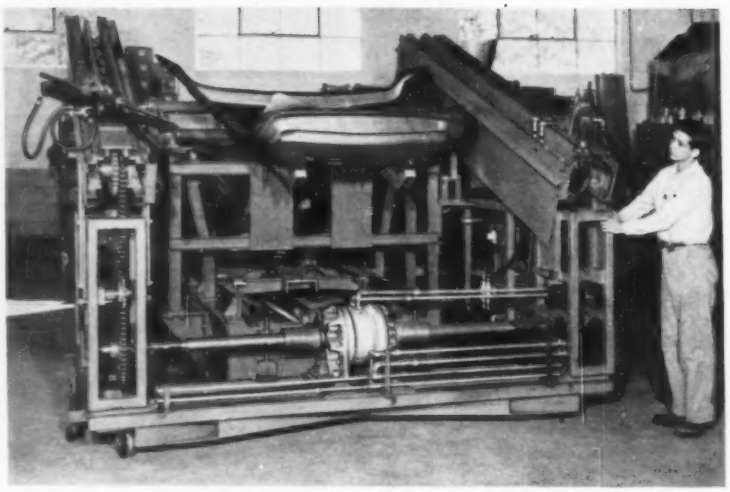



Fig. 2. R. K. LeBlond "Admiral Two-120" lathe with large swing for use in turning large cylindrical parts

## Press Unloader with Rotac Torque Actuator

A standard Rotac torque actuator manufactured at the Greenville, Ohio, plant of the Ex-Cell-O Corporation actuates the press unloader illustrated, which is a product of Press Automation Systems, Inc., Centerline, Mich. This machine will automatically unload extra-large sheet-metal stampings directly from the press. To unload a stamping, the jaws extend and grasp the stamping automatically when the press opens. The carriages then retract, following which the jaws release the part, dropping it into a standard turnover unit. The carriages then advance the jaws into position for unloading the next part.

Circle Item 114 on postcard, page 197



Press unloader equipped with Ex-Cell-O Rotac torque actuator

## Horizontal Milling Machine

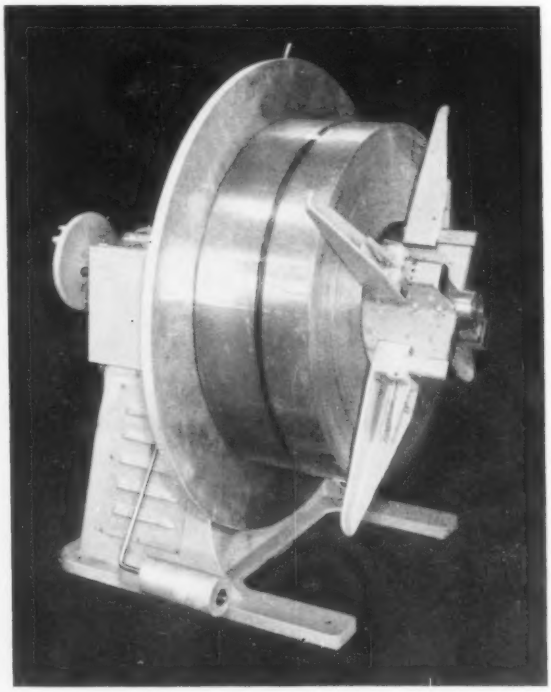
A No. 2 SAJO Model 53A light type horizontal milling machine manufactured by AB Sandens Mekaniska Verkstad, Varnamo, Sweden, is being distributed in this country by the Austin Industrial Corporation, White Plains; N. Y. The table of this machine has a working surface of 43 1/4 by 10 1/4 inches, a longitudinal power feed of 28 inches, and power feeds and power rapid traverse in three directions. The spindle has a No. 40 American Standard taper. Drive is by a 5-hp motor with dial control.

Circle Item 115 on postcard, page 197

## Motor-Driven Coiled Stock Reel

A Model ACR-1642 motor-driven centralizing reel for coiled stock has been added to the press-room equipment made by the U. S. Tool Co., Inc., Ampere, N. J. Centralizing is controlled by a

Milling machine introduced in this country by Austin Industrial Corporation



Centralizing reel for coiled stock equipped with motor drive built by U. S. Tool Co., Inc.

handwheel and an arrangement of four cross members designed to suit the inside diameter of the coil, and which expand or contract, depending on the direction of the wheel rotation. The four cross members are designed to expand and contract simultaneously.

The reel is suitable for coiled material up to 16 inches in width, with inside diameter of coil from 14 1/2 to 22 inches. It will take a coil of 16-inch wide material with outside diameter of 42 inches and inside diameter of 16 inches which weighs 2500 pounds. The reel is driven by a 2-hp motor.

Circle Item 116 on postcard, page 197

## Automatic Gear-Hobbing Machine

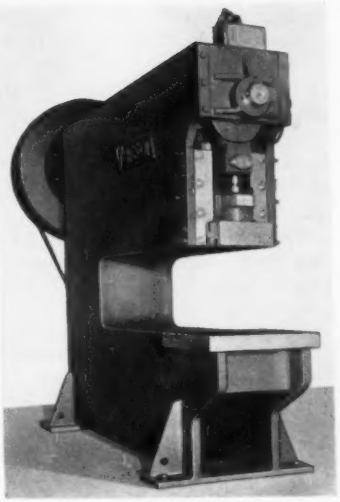
A Koepfer 170 automatic gear-hobbing machine has been introduced in the United States by the Cosa Corporation, New York, N. Y. This machine can be used for hobbing spur-, helical- and worm-gears, worms, or any work having similar generated profiles. It can be supplied with a magazine-feed that provides for fully automatic loading, chucking, and machining so that one man can operate several machines.

For small-lot runs, semi-automatic operation can be employed, using a foot-pedal control for opening the chucking device. Equipment controlled by preselection control switches can be provided for either longitudinal or plunge hobbing or combined plunge and longitudinal hobbing. The maximum number of teeth that can be cut is six; the maximum diametral pitch, 10; and the maximum blank diameter without magazine feed, 5 1/8 inches. The maximum blank diameter handled under fully automatic operation is 1 3/4 inches.

Circle Item 117 on postcard, page 197

## Verson Deep-Throat Punch Press

A punch press of 50-ton capacity with a throat depth of 60 inches has been built by the Verson Allsteel Press Co., Chicago, Ill. The press has a slide area 10 by 12 inches and a 2-inch stroke. It will be used for punching operations on large sheets. Equipment includes mechanical clutch and brake unit, square type gibs, and automatic lubrication system. The press is of all-steel welded construction, requires a floor space approximately 40 by 120 inches, is 115 inches high, and weighs about 17,000 pounds.



Deep-throat punch press built by Verson Allsteel Press Co.

Circle Item 118 on postcard, page 197

## Precision Bench Shaper

An improved precision bench shaper with an adjustable ram-stroke range from 0 to 7 inches is being manufactured by the South Bend Lathe Works, South Bend, Ind. This machine is

Koepfer automatic gear-hobbing machine

South Bend precision bench shaper

equipped with an automatic pressure-lubrication system to insure smooth and quiet operation at high speed. The stroke-length setting is indicated by graduations on the rocker-arm shoe. Stroke rates range from 42 to 195 per minute, and cutting speeds, from 3 to 114 feet per minute.

The tool-head has a 3-inch feed and can be swiveled to any angle. Power cross-feeds range from 0.002 to 0.012 inch with a maximum travel of 9 1/2 inches. Vertical travel of the table is 5 inches. The work-table is 6 5/8 inches long, 5 inches wide, and 5 3/8 inches deep. It has slots and holes on top and both sides for clamping work-fixtures, or a vise with a graduated swivel base. Vise jaws are 4 inches wide, 1 inch deep, and have 4-inch opening.

Circle Item 119 on postcard, page 197

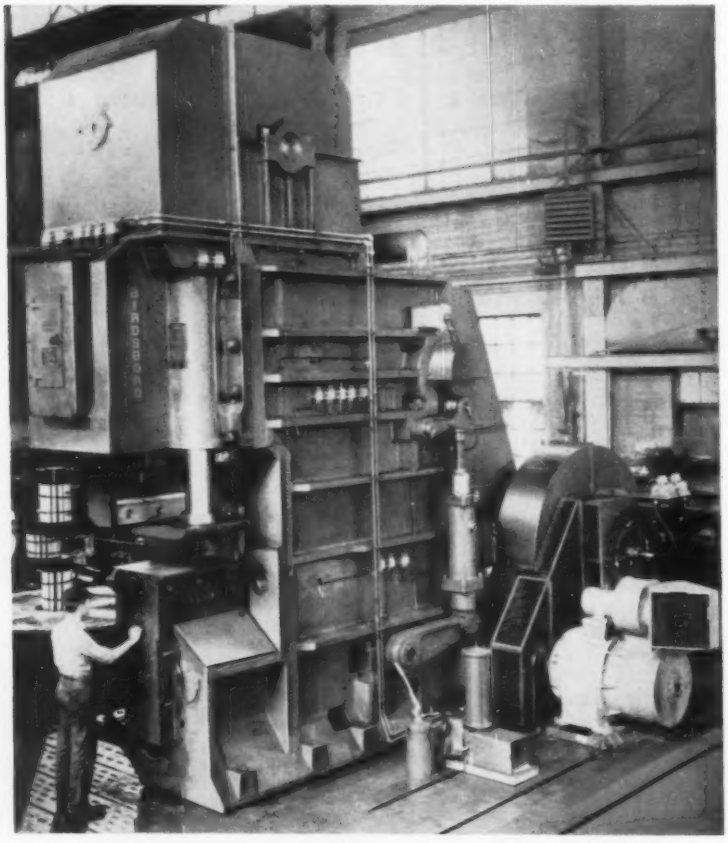
## Birdsboro Giant-Size Mechanical Shear

A 1000-ton up-and-down cutting shear, said to be the largest machine of its type in this country, has been designed and built by the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., for a leading American steel producer. This shear will be used to cut hot steel blooms up to 16 inches square, and slabs up to 6 1/2 by 42 inches.

Unlike most standard shears, this machine accomplishes its cutting action by the rising movement of the bottom knife. A special hold-down device is integrally linked to the bottom knife during the upward cutting stroke. The resulting clamping action holds the work firmly in the cutting plane and results in blooms and slabs with square-cut ends.

This air-clutch equipped machine with flywheel drive is operated by one 200-hp air-cooled alternating-current motor. Low operating and maintenance costs are claimed. The shear can complete one cut in 4 1/2 seconds. The crankshaft has a speed of 13 rpm.

Circle Item 120 on postcard, page 197.



Birdsboro giant-size mechanical shear built for steel mill

Alva Allen tilting punch press

## Tilting Power Punch Press

A Model BT-12 press of 12-ton capacity, which can be tilted to 30 degrees, is available in either a bench or floor model from Alva Allen Industries, Clinton, Mo. The bronze-bearing flywheel of this press weighs 160 pounds and assures ample power for driving the crankshaft, which is 1 3/4 inches in diameter, and provided with an adjustable tension brake. The bronze main bearings are 1 3/4 inches in diameter and 3 inches long. Specially designed hardened striking pins in the flywheel, acting with the new hardened clutch-engaging pin, are said to give positive, reliable action.

Clutch control can be easily changed from repeat (single stroke) to non-repeat (continuous) action. The ram can be easily adjusted up to a full 1 3/4-inch stroke, and locked. Split two-piece ram, ram knock-out, and hold-down slots at bottom of the ram facilitate die changing. The throat depth is 5 inches and the shut height, 7 inches.

Circle Item 121 on postcard, page 197

Reading Rockwell hardness of metal at high temperature in Wilson hardness tester

## Hardness Tester for Metals at Elevated Temperatures

Testing the hardness of hot metals by means of a Rockwell tester, used in conjunction with a small electric furnace, is a recent development of the Wilson Mechanical Instrument Division, American Chain & Cable Co., Inc., Bridgeport, Conn. The unit is shown in the accompanying illustration. It is especially intended for use in the development of metals for turbo-jet engines, rockets, and missiles. Because metals used in these products must be able to withstand high temperatures and pressures, it is essential that the metallurgist know their hardness properties and characteristics when subjected to high temperatures.

The Model 6-JR hot hardness tester illustrated determines the Rockwell hardness of the metal test piece contained within the shell of the controlled-atmosphere gas furnace at temperatures exceeding 1500 degrees F. Utilization of this equipment permits the accurate measurement of the hardness of a sample specimen without cooling it to determine the depth of penetrator impression. The approximate Rockwell hardness of the piece is automatically indicated on the dial gage.

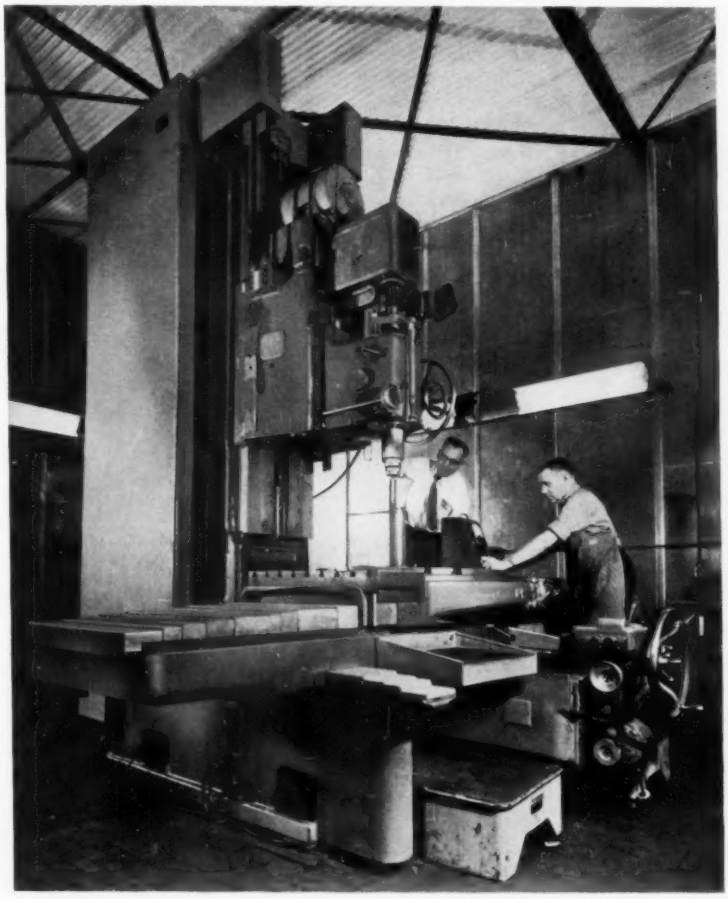
Circle Item 122 on postcard, page 197

## Giant-Size Pratt & Whitney Jig-Boring Machine

A precision jig-borer with a work-size capacity said to be the largest of any existing machine of its type has been announced by the Pratt & Whitney Co., Inc., West Hartford, Conn. This machine is designed for precision machining or inspecting components of any height up to 70 inches. It is capable of locating work accurately to 0.0001 inch and can bore to the center of a work-piece 80 inches in diameter. Models of the machine, known as the 4EA jig-borer, are available with or without numerical control.

Machines equipped with the manufacturer's numerical-control system provide automatic positioning of the rectangular worktable, and can—if desired—be arranged to control the indexing of a built-in 48-inch rotary table. With numerical control, the table is usually positioned by data fed into the machine's control system by means of a punched tape. However, where tape control is not desired, the operator can position the table by using one of the two control stations. The compact stations feature a newly designed control system that allows the operator to dial the desired positioning data as easily as he would dial a phone number.

With the first of these stations located at the front of the bed and the second located on the spindle head, one or the other is always conveniently near the operator's hand regardless of work size. A constant double-check on the correctness of all settings is made possible by having all input data from the tape or dial system always clearly shown on a display



Pratt & Whitney jig-boring machine developed to handle extra large work

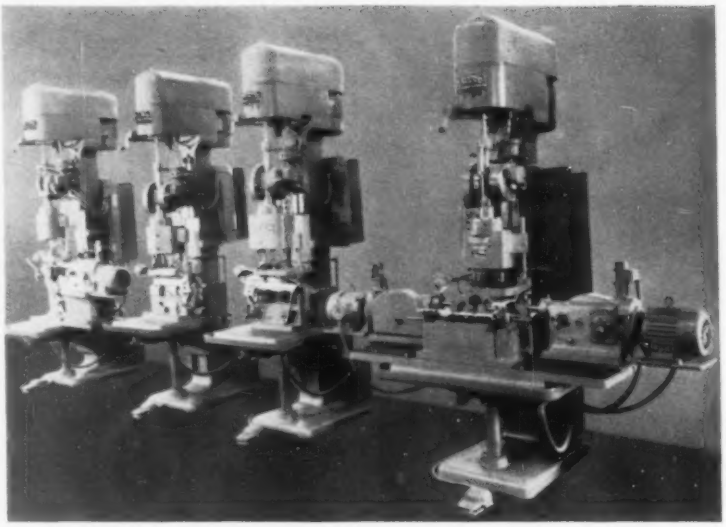
panel located on top of the tape reader. The machine weighs approximately 26 tons, and is especially adapted for use in the aircraft, missile, and atomic reactor manufacturing industries.

Circle Item 123 on postcard, page 197

### Cam-Actuated Feeds for Precision Drilling

Drilling machines equipped with cam feeds available from the Edlund Machinery Co., Cortland, N. Y., have been set up in one of the larger automobile plants, for precision drilling and countersinking of multiple holes in auto window ventilator frames. Multiple holes are drilled and countersunk on different planes.

Circle Item 124 on postcard, page 197



Machines equipped with Edlund cam feeds for drilling window ventilator frames

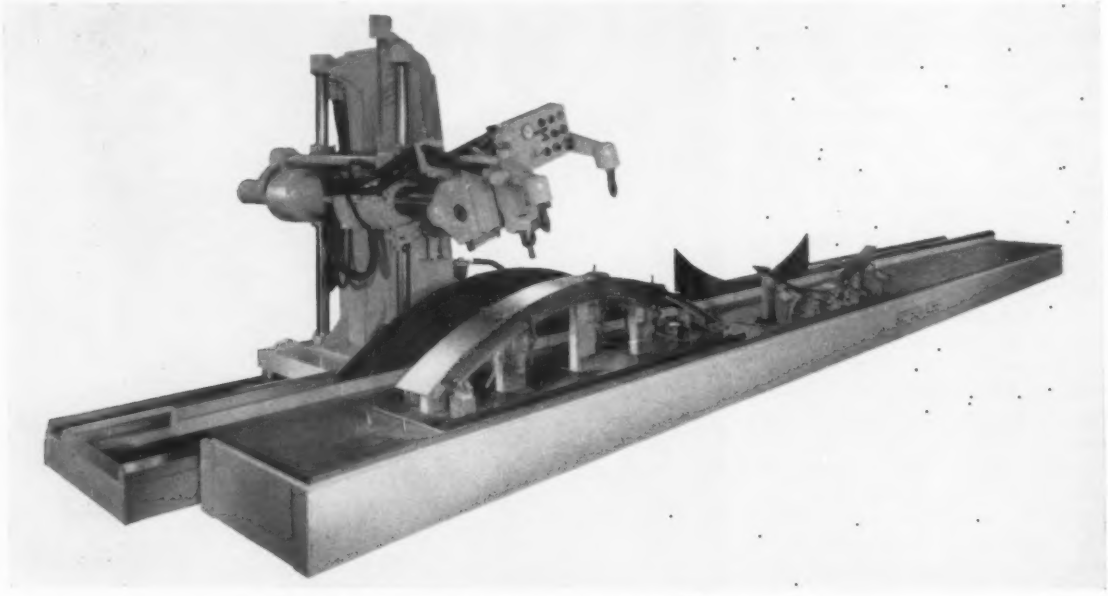
### Stetson-Ross Travelling-Head Router

The Stetson-Ross Machine Co., Inc., Seattle, Wash., has just installed its second travelling-head router at the Boeing Airplane Co.'s Seattle plant. This Model 680 machine provides three-dimensional as well as rotational movements for making beds and pocket cut-outs in extruded and rolled aluminum sections having varied amounts of longitudinal curvature. The cut-outs are made with a two-position (vertical and horizontal) spindle router motor which travels the length of the machine. The spindle is driven by a 10-hp motor. An oil-mist coolant system is provided for the cutter.

The variable-speed drive feed rates range from 2 to 40 inches per minute in slow speed, and from 6 to 120 inches per minute in the fast speeds. Any combination of feed rates up to 200 inches a minute is available. The carriage will move longitudinally 35 feet on four anti-friction rollers mounted to give a three-point suspension system.

The fabricated-steel base has a work surface 35 feet long by 32 inches wide which is 18 inches above the floor. Spacers are used to raise the work level to 30 inches above the floor.

Circle Item 125 on postcard, page 197



Stetson-Ross travelling-head router with fixtures attached to base

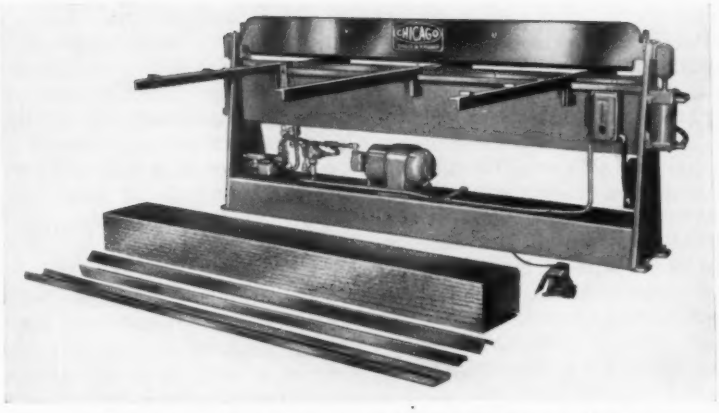
## Chicago Speed-Bender for Sheet Metal Work

The Dreis & Krump Mfg. Co., Chicago, Ill., is adding a Speed-Bender to its line of Chicago press and bending brakes. This machine is particularly suited to production bending of heating and ventilating-duct section and similar long, light-gage work. It has a capacity for bending 8 feet of 24-gage galvanized steel. Besides adjustable front gages, there are two disappearing pin gages in the lower die, which can be used to locate the bend from notches in the sheet.

The machine is furnished with a removable 90-degree die having a 7/16-inch opening. The ram, also removable and adjustable, has a 1 1/2-inch stroke and serves as an acute-angle external or punch-shaped die with the bending edge induction-hardened for longer life.

Power operation is furnished by two cylinders and a balanced vane type hydraulic pump driven by a direct-connected 3-hp motor. An on-off push-button station is mounted on the front of the machine. Operation of the machine is controlled by a foot switch that can be positioned to suit the operator's convenience. The approximate weight is 1800 pounds.

Circle Item 126 on postcard, page 197

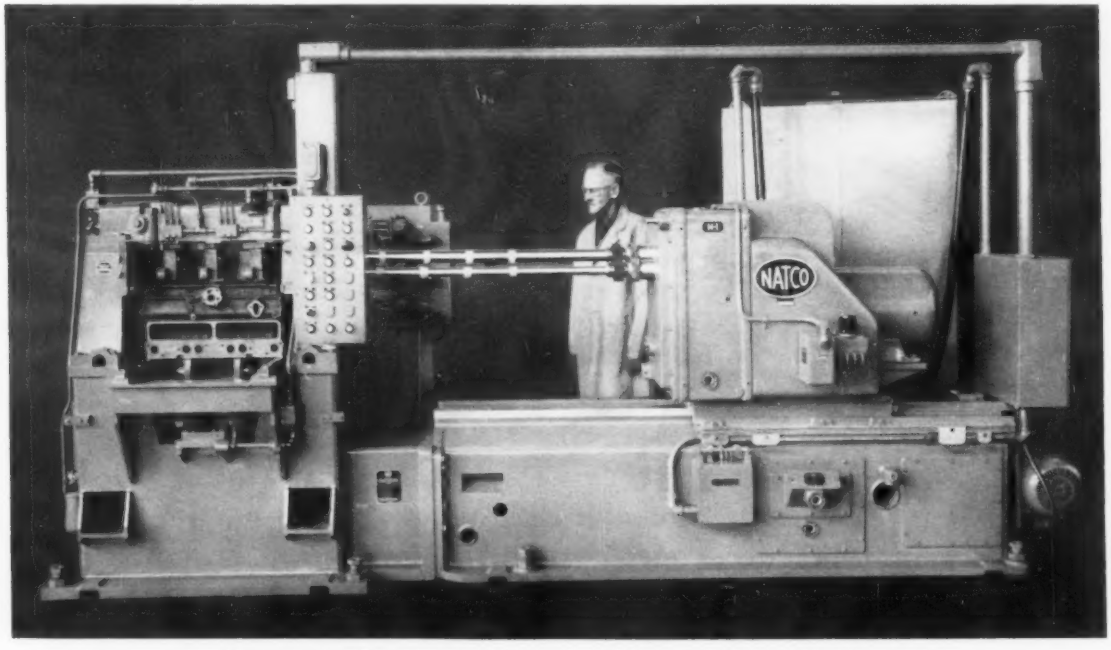



Chicago Speed-Bender announced by Dreis & Krump Mfg. Co.

## Automatic Horizontal Boring Machine for Processing Cylinder Blocks

The camshaft and crankshaft bearings in automotive cylinder blocks are finish-bored at a production rate of 58 parts per hour on a Natco horizontal boring machine built by the National Automatic Tool Co., Richmond, Ind. The boring-bars and tools of this machine are passed through bushings which support the bars, and through the previously machined bores.

The cylinder block is delivered by conveyor to the fixture, where it is first elevated so that it lines up approximately with the bushings. The boring-bars are automatically located in a radial position so that the tools line up with clearance slots in the bushings as the bars move in. At this stage, the block is positioned so that the bars move through the bores off




Natco automatic boring machine equipped for processing cylinder blocks

center, thus allowing the cutting tools to pass through without marking the part. When the bars are in place, the block is finally positioned over locating pins up against a face so that the tools are lined up properly for cutting. After the cuts are completed, the entire procedure is reversed and the boring-bars are retraced. The head is 18 by 22 inches and has two helical-gear, ball-bearing spindles which drive the boring-bars.

Circle Item 127 on postcard, page 197

### Hy-Flex Milling Machine

The U. S. Burke Machine Tool Division, Cincinnati, Ohio, has announced a Hy-Flex milling machine designed for high-production applications. This single-column machine can be equipped with as many as three spindles, positioned as required, and with any desired electrically controlled, hydraulic table feed cycle. The machine illustrated has two precision spindles, and was built to mill accurately located and dimensioned angle slots in an automotive part. Two work-pieces are simultaneously loaded into air-operated fixtures mounted on the machine table. Each spindle machines one slot as the table feeds longitudinally. The fixtures are unclamped automatically on the return movement.

Circle Item 128 on postcard, page 197

### Centrifuge for Clarifying Coolants

A centrifuge, designed to clarify coolants for grinding, honing, lapping, polishing, and cutting machines, as well as for equipment having many other industrial uses, has been developed by the A. M. Lavin Machine Works, Hatboro, Pa. This device is adapted for liquid processing and particle separation as well as coolant clarifying. A simple installation may be made on any machine with pipe fittings or rubber hose.

The equipment is manufactured in two models, No. 510 which has a capacity of 150 gallons per hour, and model No. 515, with a capacity of 1000 gallons per hour. The centrifuges may be used in multiples for larger-volume applications.

Lavin coolant clarifying centrifuge

Circle Item 129 on postcard, page 197

### Turret-Indexing Machine Chassis

A Series "M" line of standard turret-indexing machine chassis for use in economical construction of special automatic machines requiring a rotary intermittent motion has been announced by Swanson-Erie Corporation, Erie, Pa. This addition to the manufacturer's line offers designers a wider selection of standard indexing type units to meet practically all requirements for processing,

Hy-Flex milling machine built by the U. S. Burke Machine Tool Division

Swanson-Erie indexing chassis with overhead reciprocating tool plate

assembling, and light secondary machining operations.

It has an "umbrella" type tool-mounting plate that is vertically actuated during the dwell time of the turret-indexing cycle. This circular tool plate is rigidly mounted on a reciprocating center post that projects through the center of the chassis as shown in the illustration, making all the points about the turret accessible for tool mounting at any work station. Vertical actuation is entirely mechanical and is provided by means of a lift cam that is coupled to the turret-indexing mechanism. The chassis can also be furnished with a rotating center shaft designed to accommodate cams for actuating devices from inside the turret which is available in diameters from 36 to 54 inches, and with a choice of 6 to 32 index positions.

Circle Item 130 on postcard, page 197

## Dynamic Balancing Machine for Jet-Engine Components

Jet-engine turbines and compressors can be dynamically balanced to within extremely close limits by the Type JDV-1000 vertical dynamic balancing machine just announced by the Tinius Olsen Testing Machine Co., Willow Grove, Pa. This machine is 9 feet by 6 1/2 feet by 14 feet high, and will accommodate any jet-engine components up to a maximum of 55 inches in diameter, 90 inches in length, and weighing up to 1000 pounds. It will balance parts to within 0.0000145 inch displacement at the bearings. The amount and angle of unbalance in both planes of correction are accurately determined by means of a highly sensitive electrical compensating system. This system eliminates the need for machine calibration, thus speeding up the balancing of a component.

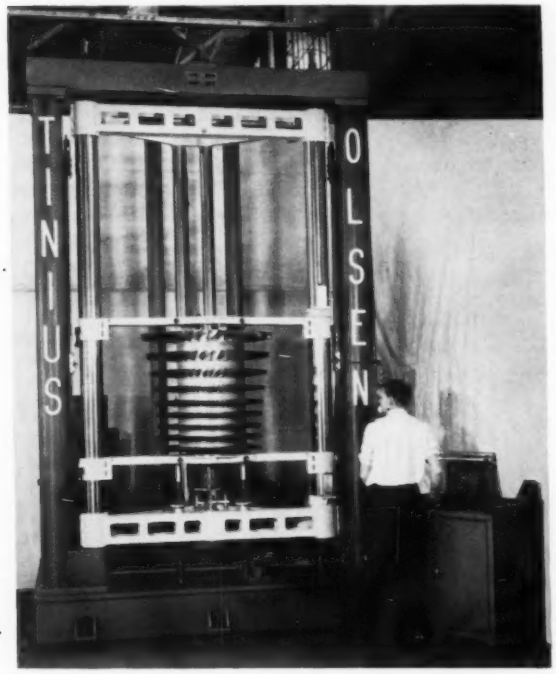
In operation, the part is inserted in the adjustable work-holders and the drive-adapter at the bottom of the shaft is engaged with the 20-hp motor drive, which rotates the part at a speed of 750 rpm. For maximum safety, the part is enclosed in a cylindrical shroud.

The operator adjusts one set of two graduated dials (angle and amount) until a minimum reading is obtained on a large electrical meter. Both the angle and amount of unbalance in the selected plane are clearly shown by the dials. These readings are retained until changed by the operator. A second set of controls is provided for the other plane of correction. This enables the operator to determine the amount and angle of unbalance in both planes without stopping the machine. The entire balancing operation—indicating, correcting and checking—is accomplished, in most cases, without removing the part from the unit.

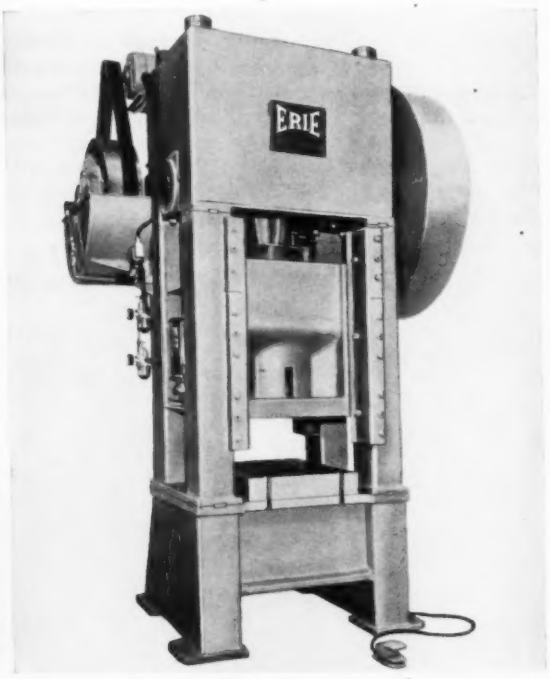
Circle Item 131 on postcard, page 197

## Line of Trimming Presses by Erie Foundry Co.

A line of single-point, straight-side presses primarily designed for trimming forgings, but also useful for stamping and drawing operations, is announced by the Erie Foundry Co., Erie, Pa. Ram,




Balancing front compressor assembly for a J-57 jet engine to within 0.0000145-inch displacement at the bearings with Tinius Olsen dynamic balancing machine




Single-point, straight-side press of line brought out by Erie Foundry Co., primarily for use in trimming forgings, but employed in stamping and drawing

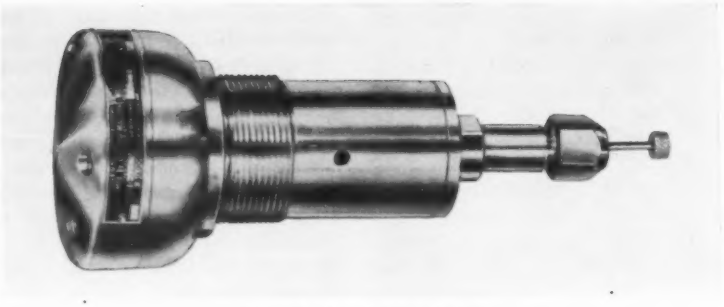
bolster, and stroke specifications conform to JIC press-room standards, which have also been followed wherever they apply to other components. The frames of these presses are of four-piece construction, and pre-stressed strain rods are used to insure rigidity. Features include: central forced lubrication, air counterbalance, and power ram adjustment. Lubricant is force-fed to all bronze bearings and guides. The pump for this system is mounted in a recessed position to protect it from damage.

The clutch is an air-operated, friction type engaged by compressed air and released by springs. The shoe type brake is released by air, and set by springs. Both the clutch and brake are designed to allow a maximum flow of air for cooling. The long guide faces of the ram are fitted with bronze guide strips, which can be replaced when worn. The press can be supplied in various speeds and strokes, and in sizes from 150 to 600 tons.

Circle Item 132 on postcard, page 197

## Air-Turbine Grinder

The Onsrud Machine Works, Inc., Portable Tool Division, Niles, Ill., has brought out an air-turbine grinder with left-hand rotation for mounting on milling machines or machine grinders. Since the left-hand rotation is in the same direction as standard machine-grinder spindle rotation, any standard dust collection setup may be used with the tool.



Onsrud air-turbine grinder

Typical applications of this high-speed grinder include slot and depth grinding, tool chip-breaker grinding, and cutter sharpening. This Onsrud DIA-LH grinder operates at 50,000 rpm. Its 1/4-hp air turbine is ample for any work resistance with grinding wheels up to 1/2 inch in diameter. End play is held to a tolerance of 0.0002 inch.

Circle Item 133 on postcard, page 197

## New Britain Multiple-Spindle Copying Lathe

The New Britain Machine Co., New Britain, Conn., has brought out a Model 412/25 multiple-spindle copying lathe. On the four-spindle machine illustrated, the work is chucked between centers and then both the driving spindles and tailstock centers are indexed together.

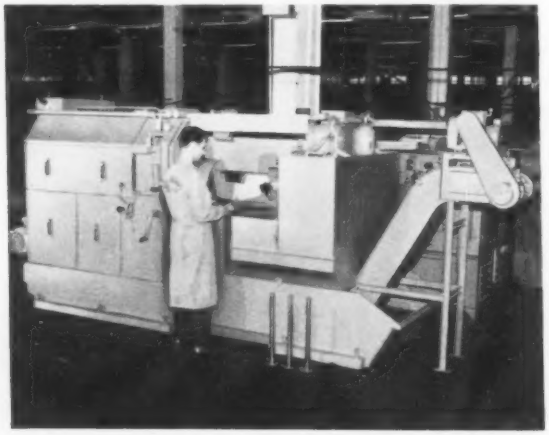
Copy turning is performed by template-operated hydraulic copying slides which can be mounted at the three work stations. For additional operations, forming arms and/or cross-slides can be mounted at the same work stations. An infeed or necking slide can also be added at the No. 1 station.

The newly designed copy slides have a 12 1/2-inch longitudinal stroke, and are positioned to suit the job. The turning capacity is 7 inches. Spindle speeds from 300 to 1500 rpm are available and are changed by pick-off gears. All slides have infinitely variable feed rates. Motor capacity ranges up to 40 hp. Optional features include two-speed spindles, automatic loading, and chip conveyor.

Circle Item 134 on postcard, page 197

## Optical Profile Grinder

A hydraulically actuated, optically controlled profile grinder called the "OPSM," built by Hommelwerke, Mannheim, Germany,



Four-spindle lathe with template-operated hydraulic copying slides brought out by the New Britain Machine Co.

Profile grinder with optically controlled hydraulic feeding system introduced by the American Laubscher Corporation

is being distributed in the United States by the American Laubscher Corporation, New York City. To operate this machine, the desired profile is drawn on a transparent plastic sheet to any selected enlarged scale within the range of 10 to 1 and 50 to 1. This drawing is placed on the projection table. The projection screen then shows in sharp focus: a portion of the profile drawing; the corresponding section of the work-piece; the cutting edge of the grinding wheel; and grinding allowance.

The optical control system operates on the principle that the feed movements to the table are guided by a specially designed hydraulic system that ensures a uniform rate of feed in all directions. The operator can see on the projection screen the grinding wheel, work-piece, and drawing, as well as a glass plate marked with a number of parallel lines. The directional positions of these lines correspond exactly to the direction of any movement imparted to the table. In other words, he can see on the screen the direction in which the work-piece moves past the grinding wheel.

If the direction of the feed has to be altered, only a movement of the glass plate is necessary. This is done by one steering wheel which rotates the glass plate, the rotation being observed on the projection screen. The hydraulic system is connected to and controlled by the glass plate. As the glass plate is rotated, the grinding wheel will follow (relative to the work-piece) the direction indicated by the arrows marked on it. The number of feeds is infinitely variable, but once a feed has been selected it will be uniform in any direction of travel. The working surface of table is 8 by 17 inches.

Circle Item 135 on postcard, page 197

## Buhr Economatic Features Easy Setups for Machining Thirty-Six Different Parts

Partial automation of setup procedures on multiple-operation Economatics built to process as many as thirty-six different parts is announced by the Buhr Machine Tool Co., Ann Arbor, Mich. The machine shown in Fig. 1 is typical of this development. The double-end, trunnion type Buhr Economatic illustrated is equipped to drill, bore, ream, tap, and chamfer thirty-six hydraulic valve bodies of various sizes with holes having different dimensions and locations. Coarse-feed rates are set by a selector switch, and fine-feed rates are automatically initiated at the proper point in the cycle by limit switches and valves.

The machine is assembled from standard Buhr building-block components, each having a control circuit designed to suit the family of parts to be processed. Basically, the machine is a double-end, trunnion type Economatic with two opposed, horizontal, hydraulic feed units. Both heads go through standard cycles of rapid advance, coarse feed (either of two or more rates), fine feed, positive stop, dwell, and reverse.

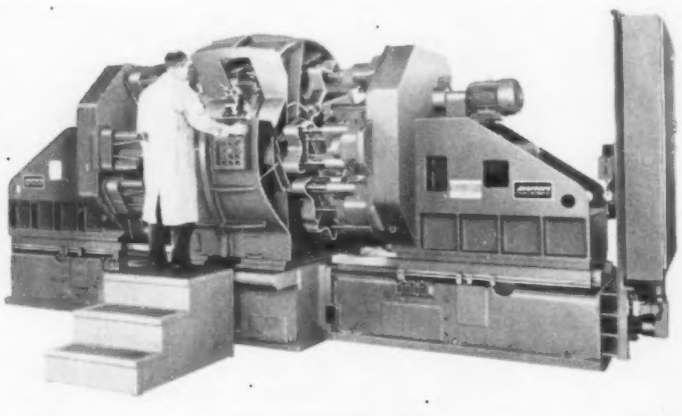


Fig. 1. Double-end trunnion type automatic machine developed by Buhr Machine Tool Co. that can be set up easily to produce many different parts

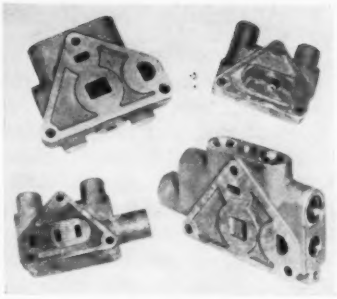


Fig. 2. Hydraulic valve bodies made on Buhr Economatic shown in Fig. 1

Most of the spindles are grouped in standard "pot" heads, but added location flexibility is achieved by also using indexing pot heads. Where different cutting speeds are required for the various parts, sets of change-gears are included in the pot.

To initiate the automatic work cycle, the operator loads and clamps work-pieces in the fixture at the loading station, and presses two index push-buttons. The trunnion indexes one station and the opposed heads automatically start their cycles. Interlocks protect both machine and operator. Tool-heads are fed hydraulically, and feed rates are established by controlling fluid flow.

All the data collected for use in designing the machine and tooling was put down on the spindle layout drawings. The spindles and tools of each head used in the production of one part are identified on a separate drawing. Since there are thirty-six parts, there are seventy-two of these drawings, all conveniently bound into a 9- by 12-inch book.

All spindles are indicated on the drawings by circles. Where the spindle is to be tooled for production of a specific part, the tooling information is set down in the circle. Thus, the setup man can see by inspection which of the spindles requires tools. Tables included on the drawings indicate which tools are to be used.

Circle Item 136 on postcard, page 197

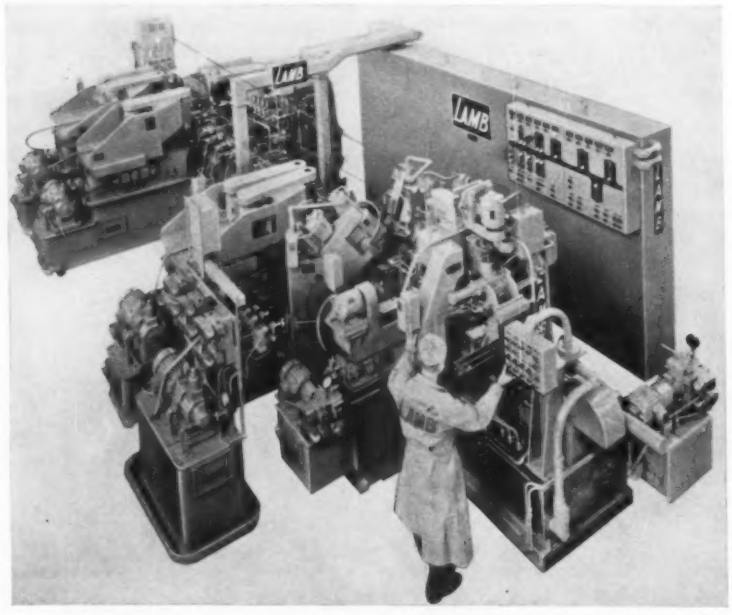
## Automatic Transfer Machine for Processing Pistons

An automatic 26-station transfer machine equipped to process 450 pistons per hour has been built by F. Jos. Lamb Co., Detroit, Mich. This equipment receives turned and grooved pistons in the dome-down position and tests the radial location of their wrist-pin holes, reorienting the part whenever necessary. Operations include: boring the wrist-pin hole, drilling a processing hole in the balance bosses and oil-holes in the wrist-pin bore, milling two slots, rough-milling two balance bosses, and rough- and finish-milling two angular flats on the piston dome. All drilled holes are probed and all pistons gaged. Those rejected for exceeding specified machining tolerances are automatically marked.

Fixtures are of simple design and most of their parts are interchangeable. Multiple clamping is designed as an integral part of the fixtures, and regulating valves limit clamping pressure to prevent part distortion. The walking-beam type transfer bar is hydraulically actuated by two cylinders, one for horizontal motion, and the other for vertical motion. The main bar carries twenty-seven box type part nests.

A pendant-mounted master push-button control is provided at the loading station for convenient right- or left-side operation. The gaging equipment stops the machine electrically if three consecutive parts are out of tolerance. Lubrication is automatic; warning lights indicate lack of lubricant pressure. The machine covers an over-all area of 20 by 30 feet.

Circle Item 137 on postcard, page 197




Piston-processing automatic transfer machine built by F. Jos. Lamb Co.

## Bliss Hydro-Dynamic and Straight-Side Presses

The E. W. Bliss Co., Canton, Ohio, recently added low-tonnage gap-frame hydraulic presses like the one shown in Fig. 1 to its Hydro-Dynamic line. The new presses cover a capacity range of from 10 to 100 tons. They are designed for quick-advance, slow-pressing, and rapid-return speeds for fast handling of a variety of flash-trimming, blanking, drawing, punching, perforating, die spotting, and similar work. The 35-ton press shown in Fig. 1 has a quick-approach and rapid-return speed of 693 inches per minute and a pressing speed of 100 inches per minute.

Another development is a line of enclosed, straight-side, double-action presses of the type shown in Fig. 2 The presses in this line are designed to operate at high-production rates, yet maintain a drawing speed of 75 feet per minute. They are available in capacities from 300 to 1600 tons, and in JIC sizes starting from 72 by 48 inches. All sizes are eccentric gear driven and have two- or four-point suspension on the inner ram.

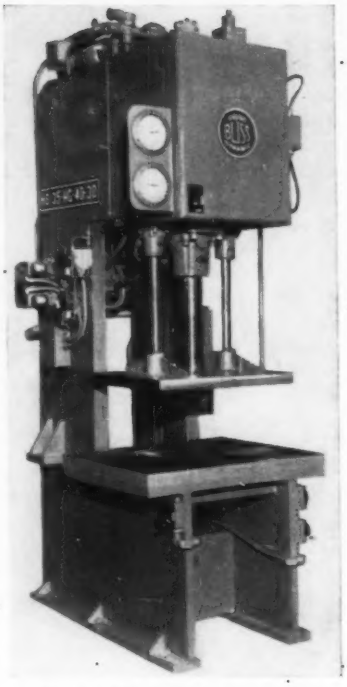



Fig. 1. Bliss gap-frame 35-ton hydraulic press

A variety of drive units is available, including the quill Type K combination clutch and brake, and the modified Type F clutch and brake equipped for two-speed operation. With Type F the highest production rates are possible through quick approach, slow draw, and quick return of both rams. Slow inching type drives are available on either type pneumatic clutch. These presses may also be equipped with the Bliss electronic press drive.

All presses can be furnished with rolling bolsters and automatic die clamping on both plunger and blank-holder slides to permit rapid die changing. When thus equipped, two alternate types of slide-positioning mechanisms are available to make full use of rapid die-changing

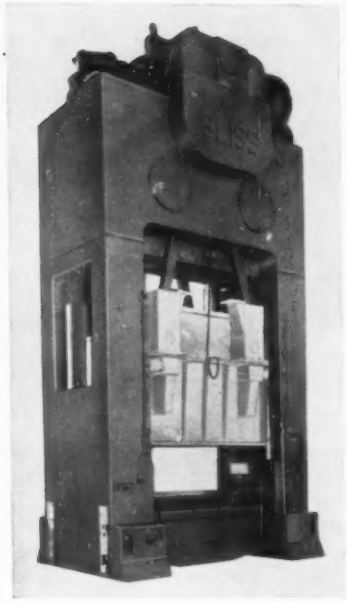


Fig. 2. Bliss enclosed, straight-side, double-action press

techniques. In both systems, the final shut-height position of both slides is pre-selected by means of dials on the master control panel.

Circle Item 138 on postcard, page 197

## Lincoln Welding Electrode

The Lincoln Electric Co., Cleveland, Ohio, has announced an E-6012 electrode developed to reduce the cost of general production and maintenance welding. The design of the coating, which includes the addition of iron powder, is said to make the electrode easier to operate and faster than previous E-6012 designs. The new electrode, called Fleetweld 7MP, is classed as an all-position, alternating- and direct-current, mild steel type. Good operation at low currents to minimize burn-through on sheet metal is claimed to be one of its advantages.

The inclusion of a moderate amount of iron powder and certain arc-stabilizing ingredients to the coating produces an electrode said to combine the ease of operation, good bead appearance and alternating-current operation of an E-6013 type, with the higher speeds and lower cost of an E-6012 electrode. It is available in the 1/8-, 5/32-, and 3/16-inch sizes.

Circle Item 139 on postcard, page 197

## Cleereman Layout Drilling Machine with Numerical-Positioning Tape Control

The application of the General Electric numerical-positioning control to its layout drilling machine was recently announced by the Cleereman Machine Tool Corporation, Green Bay, Wis. The standard model of this machine, designed as an accurate drilling and boring unit for toolroom work and medium-to-small-lot production runs, has been found especially well-suited for the application of tape control. The numerical-positioning system controls the positioning movements from numerical input data representing coordinate hole locations. The data is all digital and dimensions can be read directly from standard engineering drawings. It can be introduced into the machine by means of manually set dials, as well as punched tape. Separate, simultaneous positioning of the table and carriage follows the introduction of the digital data.

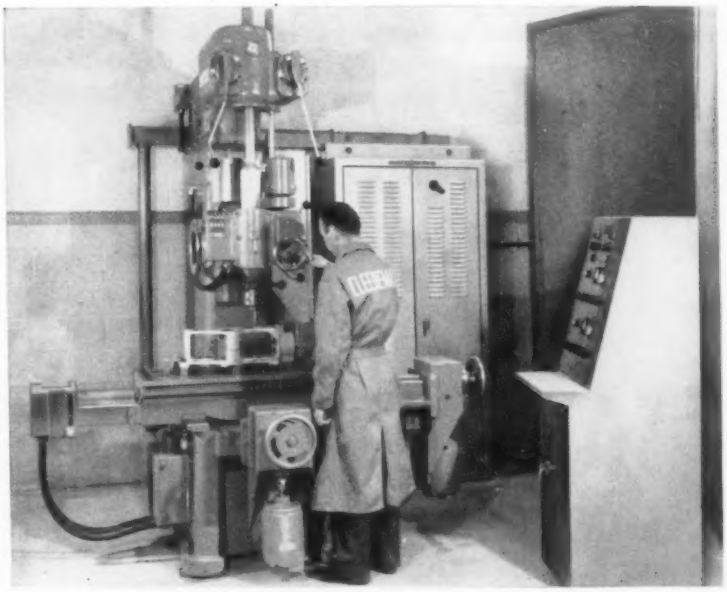
The standard tape used to supply the input data is 1 inch in width and has eight channels like those used with Flexowriter or IBM automatic electric typewriters. The tape punch automatically converts standard decimal dimensions into a simple code. Numerical information for controlling movements and auxiliary functions can be read in any sequence.

The design of the numerical control also permits the operator to position the work by manually setting up decimal dimensions on dials of the control console. Each successive hole location may be pre-selected with the digital dials while machining is in process. The dialing of input dimensions is especially useful for prototype work and single-piece production.

Several auxiliary, tape-controlled functions are available to aid machining. These include indicator lights showing operation and location numbers, rapid power-traversed spindle approach and feed engagement, selective depth control, coolant control, etc.

Once a work-piece has been clamped to the table, it is automatically positioned under the spindle for successive hole locations without wasted time or motion. Table and carriage coordinate locations can be programmed to give optimum efficiency.

Hole-location positioning accuracy is held to plus or minus 0.001 inch in 12 inches. Repeatable po-



Cleereman layout drilling machine equipped with General Electric numerical positioning system

sitioning accuracy is plus or minus 0.0005 inch. The smallest increment of positioning information is 0.001 inch. Maximum positioning speed is 60 inches per minute, and the maximum number of positioning cycles is twenty per minute. The table travel range is 14 by 28 inches.

Circle Item 140 on postcard, page 197

## Small Four-Station Drilling Machine

Zagar, Inc., Cleveland, Ohio, has designed and built a small, compact machine for processing aircraft parts. With this machine the part can be drilled, countersunk, and reamed from four sides simultaneously. The use of demountable Zagar feeder units makes it possible to vary the machining sequence as required. Additional operations can be included over and above those mentioned.

An index table with four workholding fixtures rotates the parts between the feeding cycle and the return movement of the drill heads. The feed units lend versatility to the equipment. The machine has a drilling capacity of up to 1 1/4 inches in diameter, and a rated production of 80 pieces per hour. The cycling of the machine is fully automatic.

Circle Item 141 on postcard, page 197

Tapping machine made by Kaufman Mfg. Co.

## Kaufman Tapping Machine

A tapping machine, Model 25-20, is now in production by the Kaufman Mfg. Co., Manitowoc, Wis. This machine is adaptable for both vertical and horizontal tapping. It has a capacity for 3/4—10N. C. threads in mild steel. The head is of the reversing-motor type and has a lead-screw stroke of 2 1/2 inches. Tapping speeds range from 190 to 1200 rpm. An electrically operated safety device for the lead-screw is provided to protect the machine against damage.

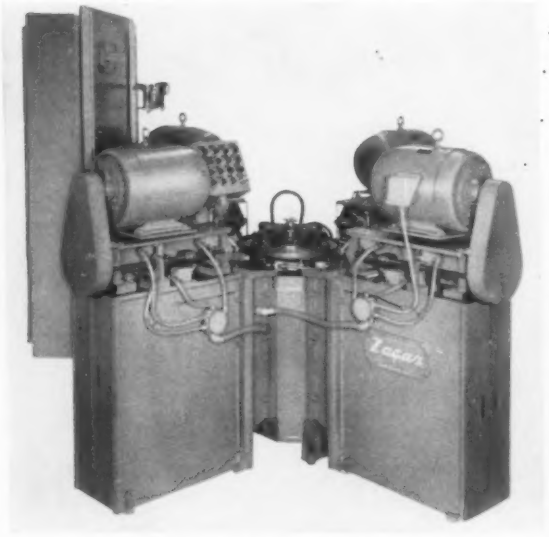
Circle Item 142 on postcard, page 197

## Automatic Parts-Washing Machine

A washing machine designed to handle all types of parts that roll is announced by the Gear-O-Mation Division, Michigan Tool Co., Detroit, Mich. This machine is adapted for horizontal installation in line with overhead parts-distribution systems of automated production lines. It eliminates the necessity for elevating parts from floor level after passing through the washer. The fully automatic washer uses integrated parts-handling equipment through both a spray wash and an air "blow-off" stage. An exclusive design feature of the parts-handling system permits 100 per cent part coverage during both the washing and drying sequences. The unit operates at high speed, the cycle time at 100 per cent capacity being only about eight seconds. Capacity for double-track washers handling is about 950 parts per hour.

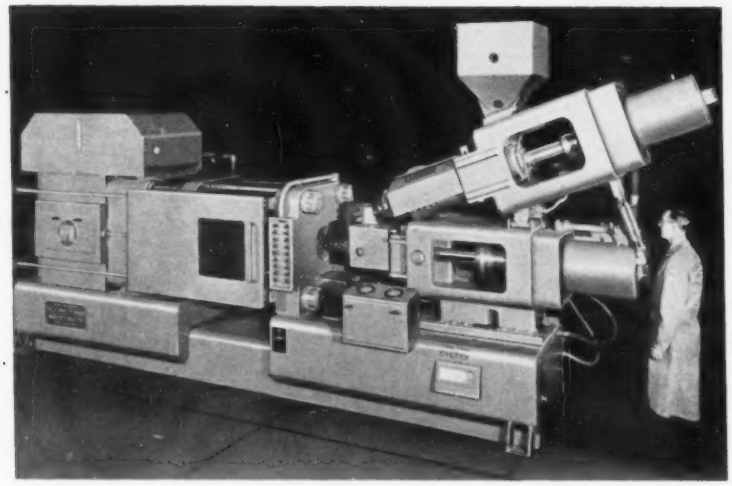
Although custom-tailored to specific applications, the washer is assembled from standard components to make it readily adaptable to a wide range of parts.

Circle Item 143 on postcard, page 197




Zagar four-station drilling machine

Automatic parts-washing machine.



Plastics injection-molding machine developed by the Hydraulic Press Mfg. Co.

## H-P-M Injection-Molding Machine

A plastics injection-molding machine has been developed by the Hydraulic Press Mfg. Co., a Division of Koehring Co., Mount Gilead, Ohio. The new preplasticizer arrangement of this machine is said to make possible the production of minimum weight parts with absolute control over the shot weight. This control is accomplished by the combined operation of a new three-way, rotary material-control valve and an adjustable stop nut.

Plasticized material stuffed into the holding chamber from the preplasticizer forces the injection plunger and the injection ram back to a positive mechanical stop, which is the adjustable nut on the front end of the injection ram. The rotary valve allows positive mechanical shut-off at a fixed pressure. This provides for positive volumetric feed of preplasticized material. The machine is built in three sizes—80-, 200-, and 300-ounce capacities.

Circle Item 144 on postcard, page 197

## Heliarc Welding Torch with Improved Water Cooling

The Linde Co., Division of Union Carbide Corporation, New York City, has announced a new Heliarc hand-welding torch designated the HW-18. The cooling-water passages of this torch are molded in the torch head, giving complete freedom from leakage. Lighter, smaller, and more rugged than previous models, the torch body is made of Fiberglas-reinforced phenolic which has exceptional heat resistance. New gas cups for the torch have improved thermal shock and heat resistance, with impact strength four times greater than that of the usual ceramic cups. For exceptionally hard use, metal sleeved cups are available.

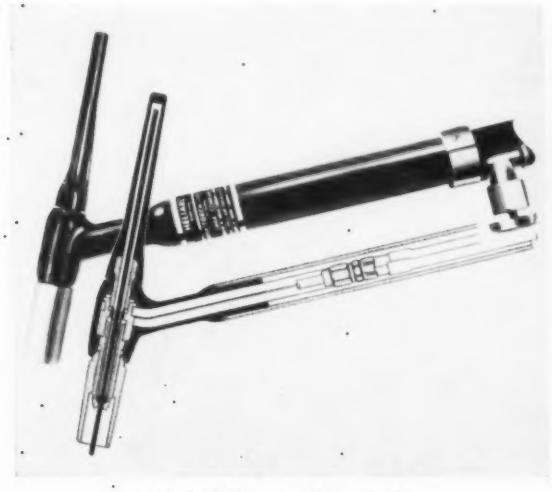
The new torch weighs only 7 ounces. Collet bodies of improved design give more efficient argon shielding and thus conserve gas. Collets, collet bodies, cups and caps are interchangeable with the Heliarc HW-17 hand-welding torch.

Circle Item 145 on postcard, page 197

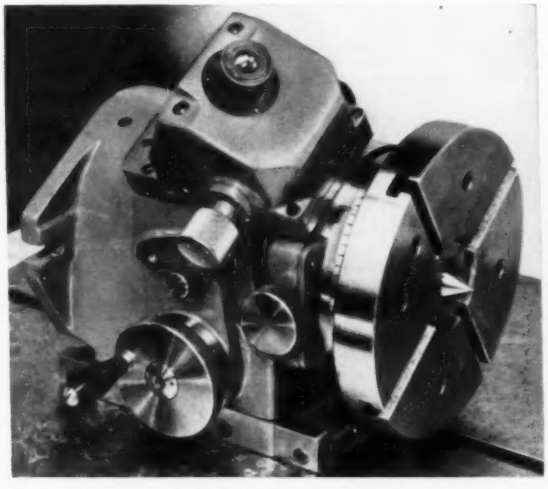
## Optical Dividing Head

The George Scherr Co., New York City, announces an OMT optical dividing head designed for inspection and light machining purposes, including the critical indexing work in manufacturing precision parts for missile-controlling mechanisms. The spindle is mounted in solid bearings in the rigidly constructed head and embodies a non-deflecting clamping device. The back face of the dividing head is precision scraped square to the base and the axis of the spindle, so that the head may

*(Continued on page 202)*



Linde Heliarc welding torch



OMT optical dividing head

## letters from production men . . .

**Thread grinders serve as research tools**

The versatility of Jones & Lamson Thread Grinders is hardly tested in the conventional production of hobs, taps, gages and threaded parts. In our toolroom, using the thread grinder as a basis for "Rube Goldberg" development we have produced precision racks, small form-profiled milling cutters, oil grooves and grinding wheel crushers.

While serving the purpose as a necessary piece of equipment, it also provides a platform from which solution-seeking thoughts may be launched in determining many additional production problems. The application of the thread grinder to toolroom problems is putting the best foot forward in achieving quick, accurate and dependable shop accessories.

*— Production Specialist —*

**One machine replaces three**

Our Jones & Lamson #5 turret lathe equipped with tracing attachment is doing the work formerly done by three conventional turret lathes. This Jones & Lamson machine does the rough and finish bore on a 6.5 diameter, 10.0 long magnesium ring. There are nine bore diameters, eight shoulder dimensions, all held to close tolerances. The accurate repetition and smooth operation of this machine reduces operator strain and produces better parts.

In our operation, full utilization of machine tools is a must. We appreciate our Jones & Lamson in helping to attain these goals.

*— Assistant Superintendent —*

**Not afraid of competition**

When the bids and quotations are opened, it's the shop with the J & L tools that gets the business. J & L turret lathes are the backbone of our job shop. Over 80% of our work is composed of machining the various alloys of stainless steel. J & L's speed, feed, power and rigidity coupled with your rapid traverse makes it possible for us to undertake jobs that our competitors wouldn't think of attempting, unless they too have J & L tools.

The availability of a J & L factory trained representative is an intangible asset to us. There isn't another machine tool builder in our area that has this service so readily available. Time and again his courtesy calls, at no expense to us, have resulted in the solving of production problems.

*— Owner —*

**Accuracy is a "must"**

We have used Jones & Lamson equipment for 17 years. In the past six months I have been partly responsible for replacing some of the turret lathes. One feature that makes Jones & Lamson our choice is the versatility possible with the 5" chuck opening.

Our principal reason for choosing Jones & Lamson again is that its rigidity and accuracy can be thoroughly depended upon for internal and external boring. The satisfaction of knowing that the close tolerances required *will* be held is vastly important in the production of our aircraft parts, because it cuts to the minimum the spoilage and rejection of parts and manhour costs.

With our future program of jet aircraft and missiles, these factors are even more important than formerly. Close tolerances and the fitting of mated parts are an absolute necessity, and we feel sure that Jones & Lamson machines will give us quality and quantity of parts to meet our requirements.

*— General Foreman —*

**Straight from the shoulder**

I am a man that came up the longest and most interesting way. Apprentice, turret lathe operator, toolmaker, Sub Foreman, Turret Lathe Foreman, Gen. Foreman, Gen. Supt. and I think I know what I am talking about. I will tell you guys in plain shop language, the best damn feature of one of the finest turret lathes built — now hold your breath. This is it. The J&L Preselector.

Features:

#1 The best design. Past, Present, and Future. You were right the first time. No design change.

#2 Ease of training apprentices and future supt's.

#3 Safe to operate. No broken backs or torn shop coats.

#4 Less motion than any other design. Means no wear, no maintenance, no down-time. Hours x man's time + burden = Dollars saved.

#5 No personnel problems, as long as you let them operate the machine with the simple preselector.

P.S. We have saved 35% with our new #5 tracer.

*— General Superintendent —*

**The lady has a point**

When we order Jones & Lamson machinery, my desk is never cluttered with unnecessary paper work. The precision, durability, and dependability of your equipment keep repairs and breakdowns to a minimum, thus saving precious time and tedious work.

Jones & Lamson machinery is help we can rely on with confidence.

*— Production Secretary —*

**A few words from Texas**

Texas is predominantly an agricultural state, and as such, raises farmers and ranchers rather than mechanics. However, it is rapidly becoming an industrial state. But — and here is the catch — farmers and ranchers are not very good machine operators.

Short runs predominate in our industry, and short runs call for turret lathes. The Jones & Lamson Hydraulic Tracing Attachment can make turret lathe operators out of farmers and ranchers in a very short time.

*— Procurement Engineer —*

**No strain — no pain**

The advanced progress in cutting tools has created a challenge to the machine tool industry. One of your answers is a heavier headstock, a heavily ribbed bed, and a rigid universal bridge carriage (supported on front and rear bed ways).

For instance: — Our new #9A-4½ J & L Saddle Type Turret Lathe performs a normally twenty minute operation in three minutes. Steel forgings (twenty inches in diameter) have one-half inch of stock removed from *both* O.D. and I.D. with a .015 feed and a spindle speed of 489 RPM. There is no sign of vibration under the strain nor does the machine falter.

"Rigidity" built into Jones & Lamson's equipment to permit a heavy cut at high speed is my answer to increased production.

*— Mechanical Engineer —*

**Tough job made easy**

The operation was rough turning cylinder barrels on a Fay automatic lathe.

This machine had 2 sets of tool blocks with 2" square tool bits, one set feeding into the cut from the front and one set feeding into the cut from the rear. The material was Chrome Molybdenum steel, hot forged. We removed as much as 100 pounds of metal from this forging in less than five minutes. The cuts were 2" wide and about ¼" thick. It was a high production job, as there are twelve of these cylinder barrels to a motor. When the chips cooled, due to the heat generated in removal, they were a deep blue color. This was as tough a job as I have witnessed. This machine demonstrated the design and quality of Jones & Lamson lathes.

*— Machine Buyer —*

*(names of these customers available on request)*

*Adv.*

**. . . to Jones & Lamson Machine Company**

512 CLINTON ST., SPRINGFIELD, VT.



For more information fill in page number on Inquiry Card, on page 197

# PRODUCT INFORMATION SERVICE

**Use postage-free Business Reply Cards for further information**
**On New Catalogues described in this issue of MACHINERY**
**On New Shop Equipment described in the editorial pages**
**On products shown in the advertisements**

## NEW CATALOGUES

**GAGES FOR MISSILE PRODUCTION**—Federal Products Corporation, Providence, R. I. Brochure titled "Precision Measuring for Missile Production," describing various types of gages for measuring critical dimensions and dimensional relationships in a variety of critical parts of guided missiles. Each gage is illustrated and the dimensions being checked are clearly described and diagrammed. In addition to strictly dimensional gages, there are also descriptions of gages for machine setup and for critical assembly operations. . . . . 1

**ASSORTED PRESSES AND MILLING MACHINES**—South Bend Lathe Works, South Bend, Ind. 80-page Catalogue No. 5800, listing precision machine tool equipment, including: engine lathes, toolroom lathes, turret lathes, vertical-spindle milling machines, bench shapers, drill presses and pedestal tool grinders. Attachments, tools, chucks and accessories for all machines are also listed. Specifications for all machines are tabulated. . . . . 2

**HOBBING PRESSES**—American Steel Foundries, Elmes Engineering Division, Cincinnati, Ohio. Bulletin 1030-B, illustrating Elmes hobbing presses for cold-forging, or coining, of desired impressions into blocks of prepared steel in the forming of duplicate die inserts, multiple-cavity molds, and single molds with unusual contours. Data includes principal specifications on all models in a wide range of capacities from 300 to 3000 tons. . . . . 3

**SPECIAL MACHINE TOOLS**—Snyder Tool & Engineering Co., Detroit, Mich. 20-page illustrated catalogue, featuring automated special machine tools for low-, medium-, and high-production operations. High-production automation concepts, including building-block principles, in-process gaging, orientation of parts in transfer, and automatic in-machine assembly, are described in considerable detail. . . . . 4

**CHUCKS**—Cushman Chuck Co., Hartford, Conn. Folder describing their line of manually operated pinch-jaw chucks. This type of chuck was originally designed and built for precision machining jet-engine discs and rings, and substantially reduces the setup time heretofore requiring jigs and fixtures while machining parts of large diameter and small cross-section, or other work-pieces unable to be held in standard work-holding devices. . . . . 5

**GRINDER CONTROLS**—Radio Corporation of America, Camden, N. J. 4-page folder, Form 3R3342, covering basic advantages of the RCA automatic controls for ID, OD, and surface grinding. A complete line of these systems is available, ranging from simple machine shut-off or alarm, size indication and segregation, to automatically self-compensating gaging and control. . . . . 6

**DRILL BUSHINGS**—W. F. Meyers Co., Inc., Bedford, Ind. Catalogue giving information about a new inserted-carbide bushing called MEYCO inserted-carbide drill-jig bushings. In addition to the complete description and specifications for slip-renewable and fixed-renewable bushings which earlier catalogues contained, the new publication also includes head and headless, press-fit types. . . . . 7

**HOBBING MACHINES**—Cleveland Hobbing & Machine Co., Cleveland, Ohio. 12-page catalogue, describing and specifying the company's line of single-spindle rotary hobbing machines. Besides complete specification data, it illustrates exclusive features and typical installations where the proper use of Cleveland Rigid-hobbers increases prdouction. . . . . 8

**FINISHING MACHINES**—Baird Machine Co., Stratford, Conn. Catalogue-data

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book detailing the company's "POLIACTION" barrel finishing machines equipped with either "Electratilt" push-button tilting controls or "Hydratilt" manual-hydraulic controls. Barrel equipment includes steam-heated, electrically heated, and drainage types for all media. ....9

**ACCUMULATORS**—Greer Hydraulics, Inc., Jamaica, N. Y. 6-page brochure PR-200, presenting different applications, sizes, and types of Greer hydropneumatic bladder type accumulators. Both the standard 3000-psi line and the 6000-psi line of Greer hydropneumatic accumulators are illustrated. .....10

**ALLOYS**—Haynes Stellite Co., a Division of Union Carbide Corporation, New York City. Two 16-page booklets, giving the properties of Haynes Stellite alloy No. 21 and Haynes Stellite alloy No. 31. These cast cobalt-base, high-temperature alloys have been used mainly in the form of investment castings. .....11

**ELECTRO CLUTCH**—I-T-E Circuit Breaker Co., Transformer and Rectifier Division, Philadelphia, Pa. Catalogue No. 6304-1A, providing detailed application reference material for use by machine tool and machinery designers and application engineers. It gives examples of actual applications, and provides data and specifications. .....12

**INDEX TABLES**—Ferguson Machine Corporation of Indiana, St. Louis, Mo. Catalogue No. 302, describing design characteristics of the roller gear-drive indexing mechanism in their line of Intermittor index tables and rotary transfer machines for high-speed assembly and manufacture. .....13

**CUTTING TOOLS AND SHARPENER**—Heald Machine Co., Worcester, Mass. Two-color, illustrated booklet No. 13-25-12, Issue 1, telling how to use cutting tools to best advantage. Formulas for determining speeds and feeds are included. One section is devoted to diagrams illustrating the terminology of single-point boring tools. .....14

**GAGE BLOCKS**—Fonda Gage Co., Inc., Stamford, Conn. Two bulletins describing the company's gage-block inspection service and gage-block sets. Bulletin 8-3 covers the types of gage-block sets available—rectangular and square, in steel and tungsten carbide; Bulletin 8-5 describes the need for and availability of gage-block inspection. .....15

**PRESS-ROOM EQUIPMENT**—U. S. Tool Co., Inc., Ampere (East Orange), N. J. Catalogue No. 85, illustrating units in a line of U. S. automatic press-room equipment. Included are U. S. slide feeds, roll feeds, air-operated feeds, stock straighteners, stock reels, coil cradles, and straighteners. .....16

**CONTOUR-MILLING MACHINES**—Onsrud Machine Works, Inc., Niles, Ill. 8-page Catalogue No. 1167, giving information on gantry type honeycomb contour-milling machines. Specific data is presented on the contour-machining of unsupported honeycomb cells and the tooling and fixture setups normally required for these operations. .....17

**PRESSES**—American Steel Foundries, Elmes Engineering Division, Cincinnati, Ohio. 24-page Bulletin No. 1010-C, illustrating complete line of Elmes hydraulic metalworking presses for drawing and forming, straightening, forcing, bending, reducing, hobbing, etc. Electric control provides semi-automatic operation, automatic operation, and inching. ..18

**TOOLING PLATE**—Dow Chemical Co., Midland, Mich. 55-page manual, covering magnesium tooling-plate properties, use of magnesium extrusions in tooling, shop characteristics of magnesium alloys, machining instructions, grinding and polishing, joining, inserts and bushings, and good shop practices. .....19

**WELDING**—Air Reduction Sales Co., a Division of Air Reduction Co., Inc., New York City. 6-page brochure, Form ADG. 2076A, presenting the function and services of Airco's machine-welding department. It describes and illustrates various types of machine-welding installations custom-engineered by this department. .....20

**FLAME-CUT STEEL**—Joseph T. Ryerson & Son, Inc., Chicago, Ill. Bulletin 50-1, giving up-to-date information on circles, rings, and irregular shapes supplied flame-cut from steel plate of any thickness. Multiple-torch setups and electric-eye equipment for guiding the cutting torches are features of the service. ..21

**CONTOURING MACHINE** — Olofsson Corporation, Lansing, Mich. 4-page bulletin, featuring a newly developed standard, cam-operated, precision contouring machine designed for combinations of boring, turning and facing—including the production of tapers, contours, grooves, undercuts, and chamfers. Complete specifications are provided ....22

**TRACER**—National Cylinder Gas, Division of Chemetron Corporation, Chicago, Ill. Booklet No. N-142, describing the Electronic Line Tracer 'Pilots' NCG Flame Cutter. Details are given about its uninterrupted cutting operation and other new features. .....23

**SWAGING MACHINES**—Torrington Co., Swaging Machine Division, Torrington, Conn. Brochure describing the Torrington electro-hydraulic die-closing rotary swaging machine. It contains a specification sheet covering all installation, operating, and adjusting information. 24

**CEMENTED OXIDE**—Metallurgical Products Department, General Electric Co., Detroit, Mich. Folder discussing Grade 0-30 cemented oxide titled "Facts about Cemented Oxide." Included are full price lists for Grade 0-30 cemented-oxide inserts, blanks, and cylinders. .....25

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**THROW-AWAY TOOLING** — Adamas Carbide Corporation, Kenilworth, N. J. Illustrated booklet titled "Throw-Away Tooling Set-Up and Follow-Thru," outlining how the user may obtain maximum throw-away tooling results through the proper use of correct style holders and inserts. . . . . **26**

**SCREW - MACHINE ACCESSORIES** — American Cam Co., Inc., Hartford, Conn. 20-page catalogue, containing complete listings of AMCAM's extensive lines of cams, cam blanks, standard and special form tools, and tool-holders, and accessories for automatic screw machines. **27**

**ULTRASONIC CLEANING**—Branson Ultrasonic Corporation, Stamford, Conn. 24-page fact-book bulletin S-200, explaining practical applications and basic principles of this modern cleaning method, as well as design of equipment. . . **28**

**ELECTRIC TOOLS**—Precise Products Corporation, Racine, Wis. Booklet listing and illustrating Precise high-speed electric tools. Included are power quills, milling machines, milling machine accessories, undercutters, etc. . . . . **29**

**TUBE MILLS**—Yoder Co., Cleveland, Ohio. Booklet illustrating Type M electric resistance-weld tube mills. It includes information concerning the number of men needed, skill and training of operators, materials for tube manufacture, etc. . **30**

**MILLERS AND TRUNNIONS**—Johnson & Bassett Inc., Production Tool Division, Worcester, Mass. Three bulletins describing its models of "Panto-Millers" and indexing trunnions. They give specifications and applications. . . . . **31**

**CLAMP DESIGN**—Wilton Tool Mfg. Co., Inc., Schiller Park, Ill. Catalogue No. 692 containing news of a C-Clamp design development, featuring Perma. Pad swivel pads which are held in place by a steel retainer ring. . . . . **32**

**CARBIDE DRILLS AND REAMERS**—Precision Twist Drill & Machine Co., Crystal Lake, Ill. 40-page catalogue, announcing the company's entry into the carbide and carbide-tipped drill and reamer market. It features the complete Precision line. . . . . **33**

**TRACER ATTACHMENT**—Tracer Control Co., Hazel Park, Mich. Leaflet, showing "E" Series Duplimatic, a high-speed, precision tracer attachment for machining contours in castings, forgings, dies, and production parts from originals, models, or templates. . . . . **34**

**SHEET FEEDER**—Dexter Co., Division of Miehle-Goss-Dexter, Inc., Pearl River, N. Y. 6-page folder, describing and illustrating production advantages of the 6000-lb. capacity Dexter TF-6 automatic metal-sheet feeder. Application information and specifications are included. **35**

**GROUND FLAT STOCK**—L. S. Starrett Co., Athol, Mass. Bulletin No. 1110, presenting Starrett No. 498 free-machining, low-carbon precision-ground flat stock. It lists the many sizes available and gives suggestions for use, specifications, and heat-treatment instructions. **36**

**SCREW FEEDER**—Zipp Screw Feeder Division, R. C. Neal Co., Buffalo, N. Y. Circular describing the Zipp screw feeder which eliminates manual screw placement and fits perfectly on all makes of pneumatic tools. . . . . **37**

**GEAR GRINDERS**—Fellows Gear Shaper Co., Springfield, Vt. Folder, describing the company's No. 12 high-production, precision-gear grinding machine with illustrations of the unit and its component parts. . . . . **38**

**WELDERS**—Lincoln Electric Co., Cleveland, Ohio. Brochure, featuring Lincoln "Mechanized Squirt Welder," with details as to reduced costs and improved quality. . . . . **39**

**GRINDING WHEELS**—Cincinnati Milling Products Division, Cincinnati Milling Machine Co., Cincinnati, Ohio. Circular PG 349, describing surface-grinding wheels, straight-sided wheels, and segments and cylinders. . . . . **40**

**MANAGEMENT INFORMATION**—Elliott Service Co., Inc., Mount Vernon, N. Y. Booklet giving information on subjects such as cost and waste control, employe training, methods improvement, etc. **41**

**MACHINE TOOLS**—Motch & Merryweather Machinery Co., Machine Tool Mfg. Division, Cleveland, Ohio. Catalogue listing circular saws, saw sharpeners, milling and centering machines, etc. **42**

**GRINDING MACHINES** — Cincinnati Grinders Incorporated, Cincinnati, Ohio. Brochure giving highlights of Cincinnati Filmatic roll-grinding machines and traveling wheel-head. . . . . **43**

**COUPLINGS**—John Waldron Corporation, New Brunswick, N. J. 4-page bulletin featuring the Waldron Standard Gear Coupling, Francke Flexible, the new 162 "M" nylon gear, and other couplings in its line. . . . . **44**

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**MILLING CUTTERS**—Portage Double-Quick, Inc., Akron, Ohio. Leaflet giving dimensions of Manchester inserted milling cutter for low-horsepower carbide face-milling of steel. . . . . **45**

**ADJUSTABLE CHUCK JAWS**—Bedford Gear & Machine Products, Inc., Bedford, Ohio. Booklet giving specifications on the company's gear top jaws, sub jaws, and chuck jaws, which may be used as attachments to other machines. . . . . **46**

**PRESSES**—Federal Machine & Welder Co., Warren, Ohio. 8-page bulletin featuring single-action, straight-side, single-crank presses in capacities of from 60 to 400 tons. . . . . **47**

**HYDRAULIC CYLINDERS**—Pathon Mfg. Co., Cincinnati, Ohio. 35-page bulletin No. 25, outlining three series of cylinders to suit all applications. Included are diagrams, illustrations, and tables. . . . . **48**

**MECHANICAL PRESSES**—Federal Machine & Welder Co., Warren, Ohio. 8-page bulletin featuring single-point, eccentric-gear presses in capacities from 100 to 1800 tons. . . . . **49**

**MOLDING MACHINE**—Hydraulic Press Mfg. Co., a Division of Koehring Co., Mount Gilead, Ohio. Bulletin No. 58P80, featuring a new 80-ounce capacity, preplasticizing type, plastics injection-molding machine. . . . . **50**

**BAND SAWS**—Cutron Mfg. Co., Lubbock, Tex. Brochure featuring band saws ready for use with hydraulic system, swivel vise, and other equipment. Models are available for wet and dry cutting. **51**

**RAM BENDERS**—Wallace Supplies Mfg. Co., Chicago, Ill. 16-page folder presenting specifications and application data on three different types of ram benders. **52**

**TOOL GRINDERS**—Hammond Machinery Builders, Inc., Kalamazoo, Mich. Catalogue No. 255, featuring oscillating, chip-breaker, and chip-breaker and cup-wheel grinders for carbide tools. All of these machines can be equipped for electrolytic grinding. . . . . **53**

**SHELL TRIMMERS**—Dayton Rogers Mfg. Co., Minneapolis, Minn. Brochure introducing the Dayton Rogers ST-4 drawn shell trimmer employing the sliding knife principle. . . . . **54**

**OPTICAL DIVIDING HEAD**—George Scherr Co., Inc., New York City. Brochure No. 54/57, introducing the Newall Group's OMT optical dividing head, Types OW7 and OW12. . . . . **55**

**SHEARS**—W. A. Whitney Mfg. Co., Rockford, Ill. Brochure describing a hydraulic angle-iron shear which can be used on floor or bench. . . . . **56**

**BALING PRESS**—Wheland Co. Chattanooga, Tenn. Folder featuring the Duomatic baler. It is a heavy-duty hydraulic press for baling scrap metal. . . . . **57**

**AUTOMATIC LATHES**—Gisholt Machine Co., Madison, Wis. Brochure giving specifications and illustrating special features of Gisholt Simplimatic automatic lathes. . . . . **58**

**TOOL STEEL**—Brown & Sharpe Mfg. Co., Providence, R. I. Circular M69, illustrating and giving specifications for precision-ground tool steel. . . . . **59**

**TOOL-HOLDERS**—Portage Double-Quick, Inc., Akron, Ohio. Booklet, listing PDQ quick-change tool-holders, adapters, shank drills, and reamers. . . . . **60**

**HONING STONES**—Jes-Cal Co., Frazer, Mich. Circular giving features of Jes-Cal Size Control Hone. . . . . **61**

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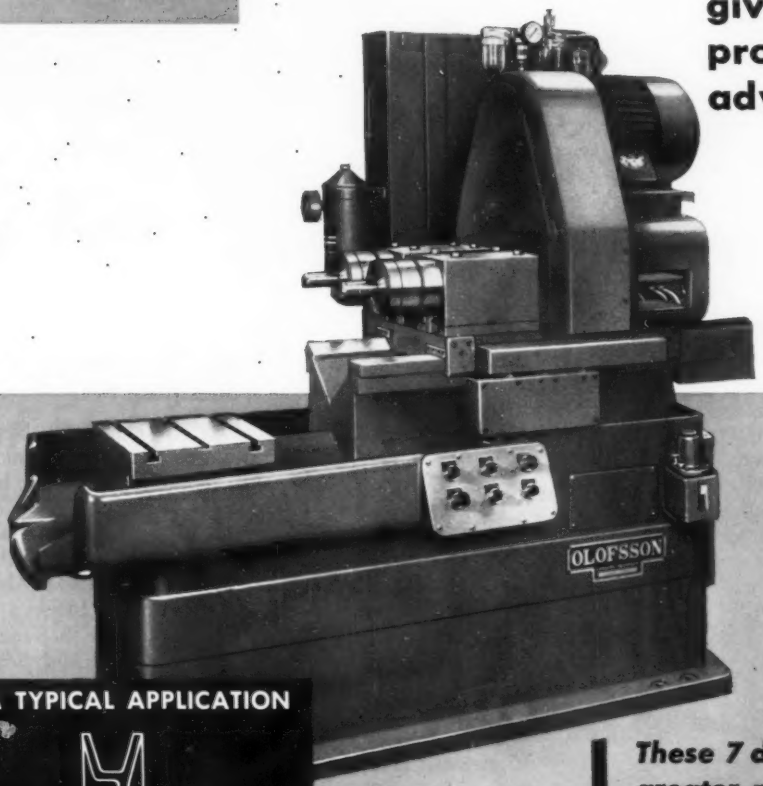
# NEW design

## *OLOFSSON* Precision Boring Machine gives added production advantages




**OLOFSSON Model 30-012 Single End Precision Way Boring Machine**

PROVIDES FAST, ACCURATE ROUGH AND FINISH BORING, FACING, CHAMFERING, TURNING AND GROOVING.

### A TYPICAL APPLICATION

Finish bore, turn o. d., groove, and chamfer zinc die-cast pulley.

Rate of Production: 190 pieces per hour.

### *These 7 design features give you greater production efficiency . . .*

1. New design provides low height to width ratio of spindles to ways.
2. Self contained hydraulic unit, separate from machine, for easy maintenance and elimination of heat problems.
3. Standard commercial hydraulic components throughout.
4. Nickel-iron, one piece ribbed base with integral fixture mounting pad and chip disposal basin.
5. Hardened and ground ways.
6. Conveniently located push-button control panel.
7. Forced feed lubrication.

FIND HOW THE 30-012 FITS YOUR REQUIREMENTS. WRITE FOR LITERATURE.

THE OLOFSSON CORPORATION

2729 Lyons Ave., Lansing, Michigan

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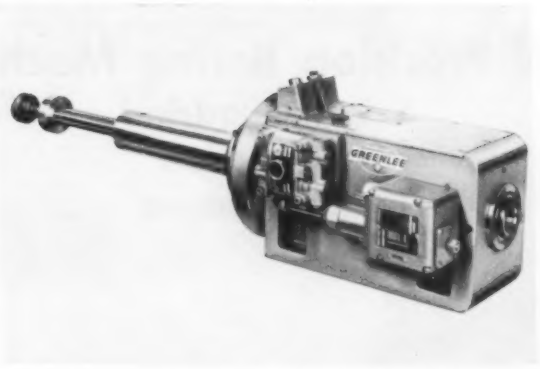
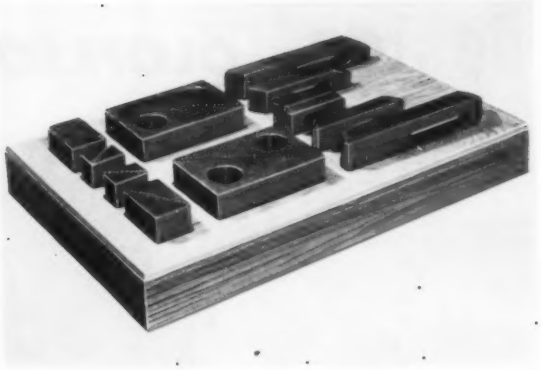



Greenlee large capacity "Hydro-Borer" unit



Northwestern step block and clamp set

be used with the axis of the spindle in the vertical or horizontal plane. Direct readings to 2 seconds of arc are accomplished by employing a micrometer eye-piece which is illuminated by a low-voltage bulb. For coarse adjustment, an external graduated-scale ring is provided close to the eye-piece.

Circle Item 146 on postcard, page 197

### "Hydro-Borer" Unit

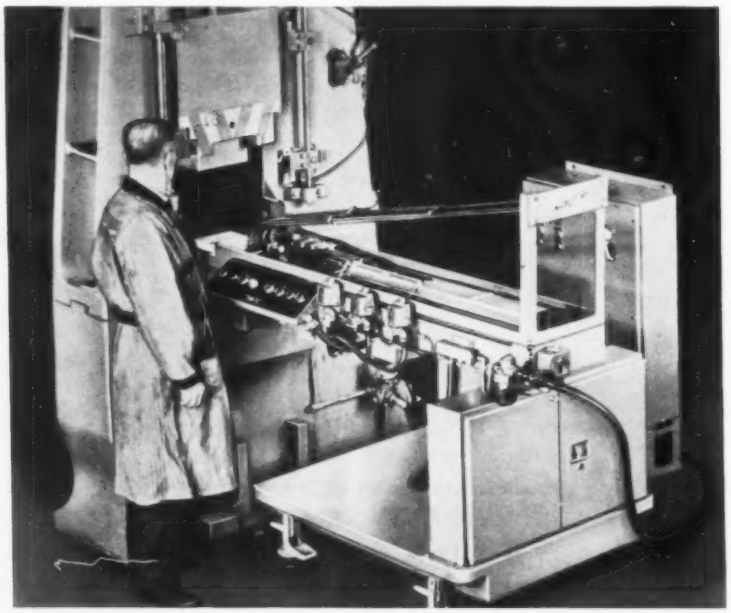
Greenlee Bros. & Co., Rockford, Ill., has announced a larger capacity "Hydro-Borer," designated the model S-7. This low-cost, precision borer is designed for boring large assemblies or small individual pieces. It is exceptionally compact for its heavy-feed capacity. Over-all dimensions are: length 34 1/2 inches, height 7 3/4 inches, and width 5 1/2 inches. the spindle is 1 3/4 inches in diameter and has a No. 3 Morse taper. The length of stroke is 6 inches, feed per revolution is 0.0035 inch, reducible to 0.002 inch. Speeds of 465, 900 and 1400 rpm are available. The S-7 unit is specifically designed for mounting on work-holding fixtures or large assembly jigs. It can be equipped with manual, solenoid, or air-operated controls.

Circle Item 147 on postcard, page 197

### Step Block and Clamping Sets

Step block and clamp sets have been added to the line of hold-down and clamping tools made by Northwestern Tools, Inc., Dayton, Ohio. The illustration shows clamps for 1/2-inch bolts with standard 1-inch wide blocks. Also available with standard blocks are clamps for 3/8- and 5/8-inch bolts. Clamps for 1/2- and 5/8-inch bolts, along with clamps for 3/4-inch bolts, are also sold in a "heavy-duty" set with blocks 1 1/2 inches wide. Clamps for 1-inch bolts are available in a double-duty set.

Circle Item 148 on postcard, page 197



Chambersburg "Forming Drop" hammer with feeding device

### "Forming Drop" Hammer Feeding Device

The Chambersburg Engineering Co., Chambersburg, Pa., has announced a type of feed which permits semi-automatic re-striking or coining of forgings when used in conjunction with this company's electrically controlled gravity drop-hammer, known as the "Forming Drop". The feed is especially designed for coining operations and is mounted on a movable base adjustable to various die heights. If access to the die area is necessary, as for die changing, the feed may easily be swung out of the way. Magazine and pusher plates can be changed to suit different forgings. Or, when desired, the entire feed mechanism can be moved to permit hand or foot operation.

Circle Item 149 on postcard, page 197

*(This section continued on page 204)*

# What! Painting or Etching to Suit the Occasion!

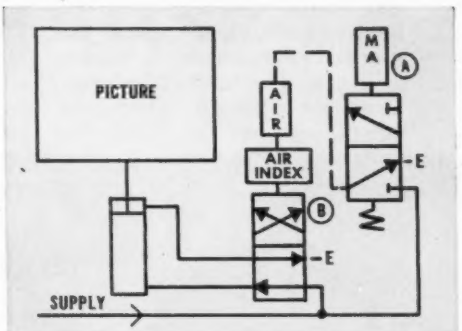
**This "one knob picture control" is unlikely we will agree, but . . .**

Art tastes do vary. The boys may not wish to share theirs with the spouses . . . in fact they may not *dare* to. And it might even call for a quick disappearing act for the little lady who is wearing little more than a blush. Unlikely as this device is, it would efficiently accomplish this neat scene change for such "art lovers." In the meantime, it gives us a chance to show something new. How one valve can now extend a double acting cylinder, letting it remain extended when the valve is released, then retract the cylinder at the next actuation by using the new Ross momentary air index adaptor.

**The Ross air indexing momentary has hundreds of serious uses**

Now, a standard Ross Skyline valve, either solenoid or air operated can include this momentary air index adaptor. Then the first actuation will send the valve one way and it will stay in that position, even when the actuator releases. The next stroke reverses the valve, again it stays after actuator release, etc.

See your Ross representative for application information.




SEQUENCE OF OPERATION

1. Valve (A) is manually actuated, valve (B) reverses and stays put, keeping pressure on one side of double-acting cylinder.
2. When Valve (A) is manually actuated again, valve (B) reverses and stays put, keeping pressure on opposite side of double-acting cylinder.

Ross OPERATING VALVE CO.

110 East Golden Gate • Detroit 3, Michigan

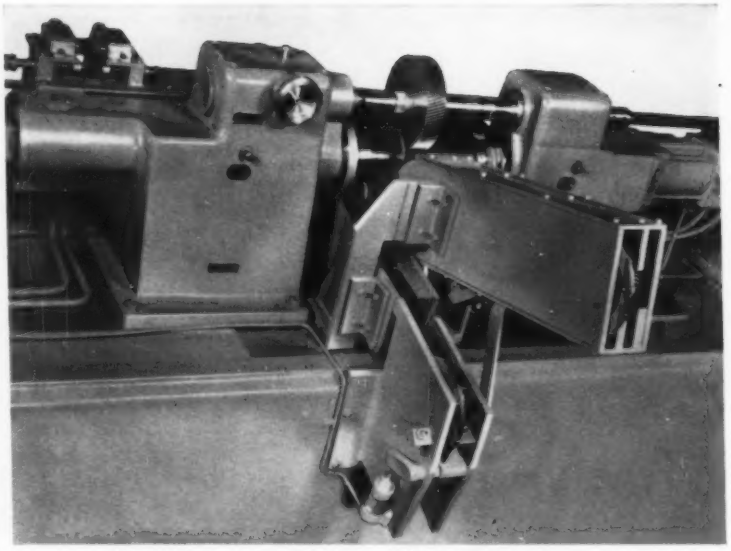
For more information fill in page number on Inquiry Card, on page 197

## Red Ring Automatic Loader for Gears with Large Flanges

A Red Ring rocker type automatic loader for handling gears with large integral flanges is available from the National Broach & Machine Co., Detroit, Mich. This loader can be installed on gear-shaving machines, gear-tooth honing machines, gear sound-testing machines, and electronic sound discriminator-speeders. It enables a machine having limited clearance between work and master gear, cutter or honing tool, to process a small gear on a relatively large-diameter part. The gear is moved automatically from its speeding or cutting position in front of the input magazine to a new position in front of the exit chute at end of work cycle.

In the application illustrated, the loader is installed on a Red Ring electronic sound discriminator-speeder. It handles a gear having a large, integral flange. In operation, a gear in the input magazine rolls into mesh with the master gear. Then the headstock advances a short distance. Tailstock and headstock pilots hold the gear by friction.

The gear is then sped in mesh with the master gear (in both directions) while the resulting sound is analyzed by an electronic sound discriminator unit. At the end of the speeding cycle, the headstock air-cylinder moves the gear and pilot assembly to the left as a unit. The tailstock cylinder moves out of the gear, which rolls into the exit chute. The headstock nose then returns to its original position. Gears that do not meet the sound test specifications are dropped out of the exit line by a solenoid-controlled gate.



Red Ring automatic loader for gears with large integral flanges installed on an electronic sound discriminator-speeder

Circle Item 150 on postcard, page 197

## "Ready Mark" Precision-Ground Tool Steel

Precision-ground, oil-hardening flat stock pre-colored a dark blue ready for marking or layout is being produced by the Brown & Sharpe Mfg. Co., Providence, R. I. This stock, known as the "Ready Mark," eliminates lost time usually consumed in bluing and drying. The rust-resistant finish does not affect heat-treatment.

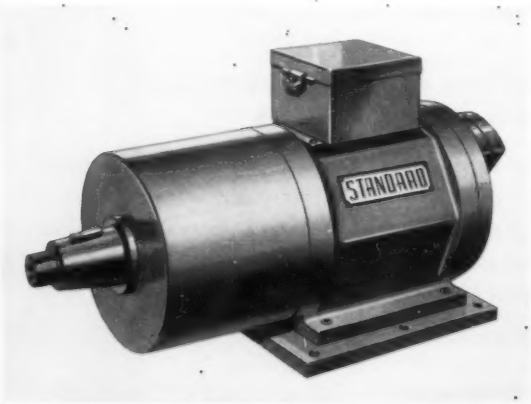
The steel has excellent machinability and the analysis is controlled by rigid specifications. It has a hardness range of 170 to 207 Brinell and conforms to AISI specification 01. Thicknesses from 1/16 inch and widths up to 14 inches are now available in 18-inch lengths.

Circle Item 151 on postcard, page 197

## Spindles for Electrolytic Metal Removal

Precision spindles for electrolytic metal removal are now made by the Standard Electrical Tool Co., Cincinnati, Ohio, for handling up to 1000 amperes. The

Brown & Sharpe pre-blued "Ready Mark" tool steel facilitates layout work




Precision spindle for electrolytic metal removal made by Standard Electrical Tool Co.

# Scotch About Profits?

*Talk to*

# Snyder

**TOOL AND ENGINEERING COMPANY**

**3400 E. Lafayette, Detroit 7, Michigan**

*Special Machine Tools with Automation for More Than 30 Years*

unit illustrated has a 5-hp motor running at 1800 and 3600 rpm. The spindle nose will accommodate a variety of wheel holders for straight or recessed wheels. Other models for 75, 100, and 350 amperes are available.

Circle Item 152 on postcard, page 197

## Electromechanical Control System

Simplified control systems of high accuracy and assured repeatability for application to machine tools and other equipment have been introduced by Seneca Falls Machine Co., Electronics Division, Seneca Falls, N. Y. These controls, first employed on tracer lathes, have many other uses, including variable and precise speed control and vibration excitation. They are also useful in process and proportioning control, servos for aircraft, trucks, automobiles, and materials-handling equipment. Systems are made for applications requiring 1/4 to 100 hp.

This electromechanical system may be used in conjunction with computers or with signal sources sensing linear motion or distance, pressure, temperature, flow, and speed—as well as with manual controls. Components of the control system include a signal comparator (electrical or mechanical), a power-supply converter, the electronic amplifier, and the mechanical power amplifier.

Circle Item 153 on postcard, page 197

## Reliance Submersible and Vertical Motors

A line of alternating-current electric motors for direct coupling to pumps which must operate continuously while submerged in oil, water, or liquid chemicals has been introduced by the Reliance Electric and Engineering Co., Cleveland, Ohio. These polyphase, single-voltage submersible motors, like the one seen in Fig. 1,

Fig. 1. Reliance submersible motor

are available in sizes from 3/4 through 15 hp.

"Liqui-Seal" construction seals in the motor oil and excludes external contaminants. A neoprene diaphragm in the motor base flexes slightly to offset minute differences between internal and external pressures, relieving pressure build-up around the positive shaft seal or O-ring seal.

Fig. 2. High-thrust, oil-lubricated Reliance vertical type motor

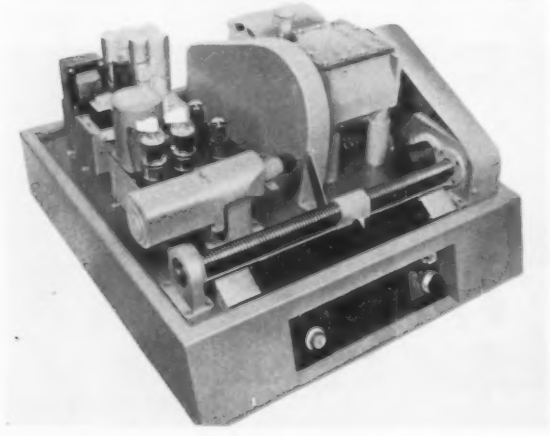
Vertical solid-shaft, high-thrust P-base motors in sizes from 1 to 40 hp are another development of the Reliance Electric and Engineering Co. These motors, of the design shown in Fig. 2, are intended for direct mounting on pumps. They are available in all standard enclosure types.

Circle Item 154 on postcard, page 197

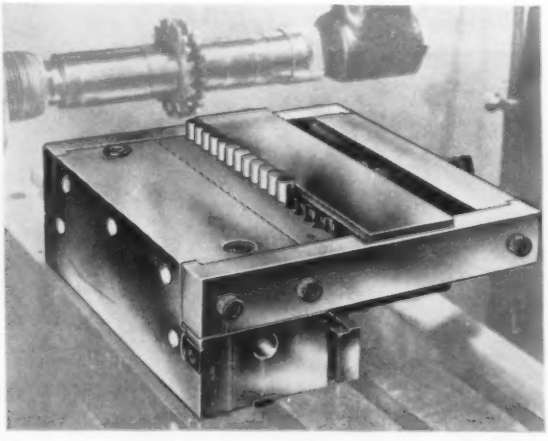
## Lassy Gang Type Work-Holding Fixture

A gang type fixture designed to hold a number of pieces securely in place to permit accurate, efficient milling and grinding in

(Continued on page 212)



Seneca Falls electromechanical control unit which includes (right) mechanical power amplifier, (lower left) displacement transducer, and (upper left) electronic amplifier



Gang type work-holding fixture with independent compensating or equalizing jaws made by Lassy Tool Co., set up for vertical milling of twelve parts in one operation

# THE ARROW PROFILER

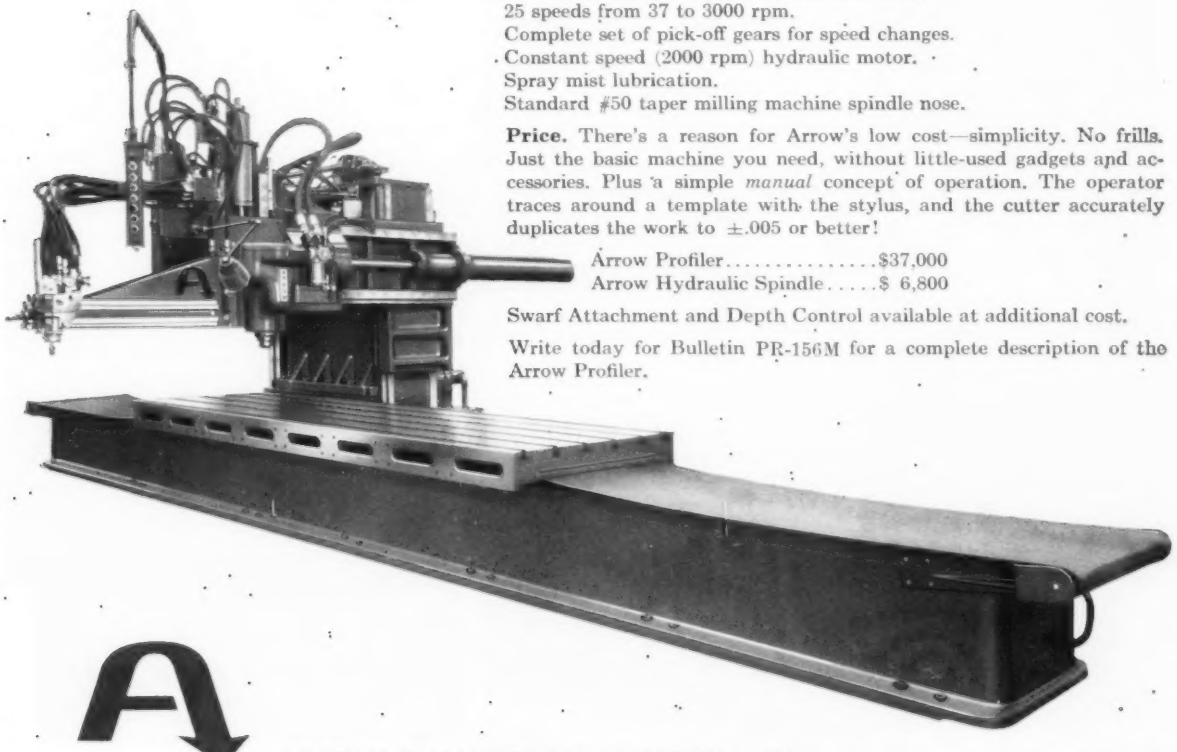
Check performance, specs and price before you buy

**Performance.** High feed, high speed, high horsepower—guts! For close tolerance, high production machining of aluminum, titanium or steel, be sure to see the new Arrow Profiler. Capable of any 360° profiling, 3-dimensional contouring, swarf or twist milling, the Arrow Profiler is easy to operate, accurate and versatile.

**Specifications, Arrow Profiler**

Table size.....42″ x 144″
Table travel.....136″
Cross travel of spindle.....48″
Feed rates.....0″–75″/min.
Table rapid travel.....150″/min.
Maximum clearance under spindle.....34″
Vertical travel of spindle on 3-D.....12″
True-Trace 3-dimensional valve.
Complete hydraulic power unit including two 100-gallon tanks, 50 hp motor, two double-end 16 gpm pumps, filters, controls and cooler.
Automatic way lubrication.
½ hp cross arm elevator motor.
Neoprene table way covers.
Complete electric wiring, 220V, 440V or 550V.
110V pendant control.

**Arrow Hydraulic Spindle** (Constant 40 hp)
25 speeds from 37 to 3000 rpm.
Complete set of pick-off gears for speed changes.
Constant speed (2000 rpm) hydraulic motor.
Spray mist lubrication.
Standard #50 taper milling machine spindle nose.



**Price.** There's a reason for Arrow's low cost—simplicity. No frills. Just the basic machine you need, without little-used gadgets and accessories. Plus a simple *manual* concept of operation. The operator traces around a template with the stylus, and the cutter accurately duplicates the work to ±.005 or better!

Arrow Profiler.....$37,000
Arrow Hydraulic Spindle.....$ 6,800

Swarf Attachment and Depth Control available at additional cost.

Write today for Bulletin PR-156M for a complete description of the Arrow Profiler.

ARROW ENGINEERING COMPANY, INC. *Walsingham Road, Largo, Florida*

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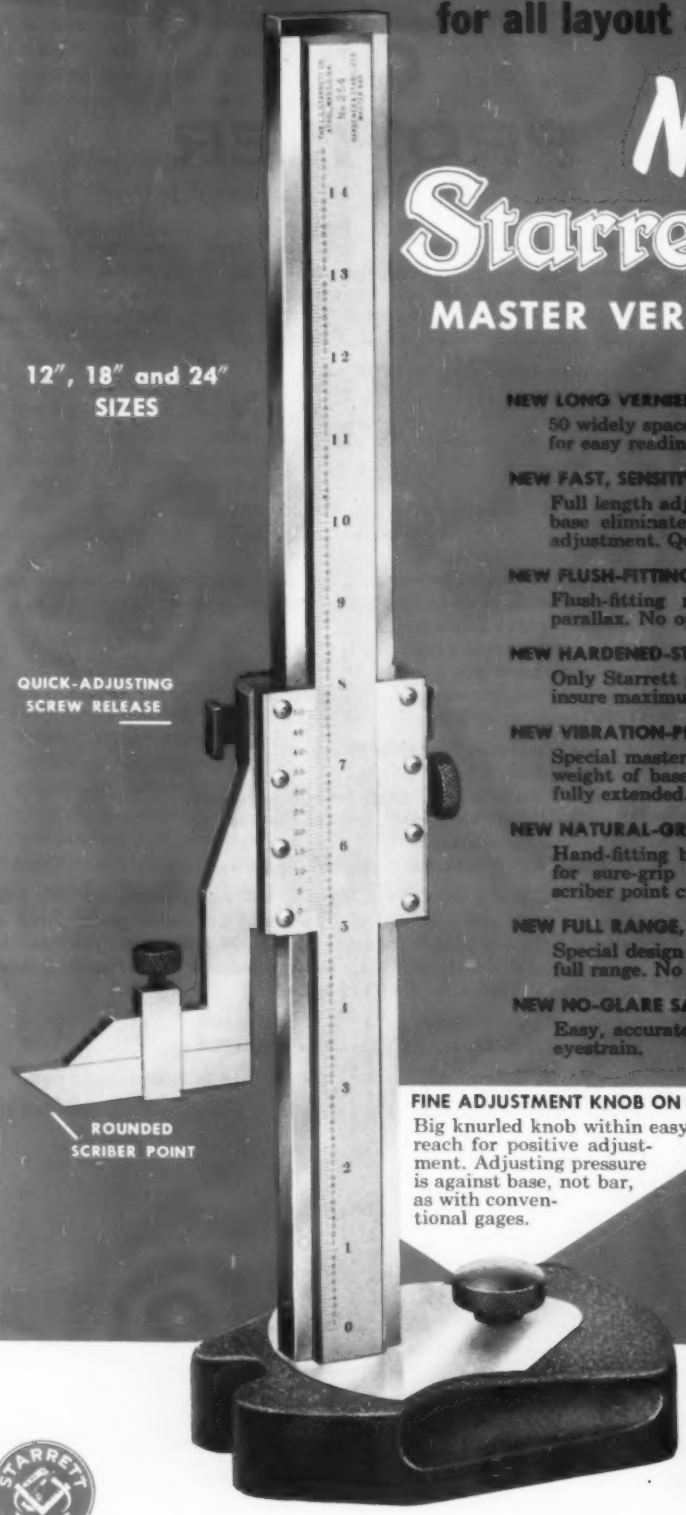
## for all layout and inspection work

# NEW Starrett No. 254

## MASTER VERNIER HEIGHT GAGE




**NEW LONG VERNIER, OPEN FACE DESIGN**
50 widely spaced graduations — half the usual number — for easy reading or setting without a magnifying glass.

**NEW FAST, SENSITIVE SLIDE ADJUSTMENT**
Full length adjusting screw with fine adjustment knob on base eliminates reaching, gives smooth, full range, fine adjustment. Quick adjustment by split nut on screw.

**NEW FLUSH-FITTING VERNIER**
Flush-fitting master bar and Vernier plate eliminate parallax. No optical reading errors.

**NEW HARDENED-STABILIZED MASTER BAR**
Only Starrett provides hardened bars on Vernier tools to insure maximum rigidity, lasting accuracy.

**NEW VIBRATION-PROOF DESIGN**
Special master bar construction plus substantial size and weight of base eliminate vibration — even with scriber fully extended.

**NEW NATURAL-GRIP BASE**
Hand-fitting base design with convenient finger grooves for sure-grip handling and easy movement. Rounded scriber point cuts clean, sharp lines with less pressure.

**NEW FULL RANGE, DIRECT READING DESIGN**
Special design permits direct readings from base over the full range. No calculations to introduce errors.

**NEW NO-GLARE SATIN CHROME FINISH**
Easy, accurate reading in any light without squinting or eyestrain.

**FINE ADJUSTMENT KNOB ON BASE**
Big knurled knob within easy reach for positive adjustment. Adjusting pressure is against base, not bar, as with conventional gages.

**Your Industrial Supply Distributor** will show you Starrett No. 254 Master Vernier Height Gage and many other new Starrett Tools. Call him for quality products, dependable service. The L. S. Starrett Company, Athol, Mass., U. S. A.

**Starrett®**
*World's Greatest Toolmakers*

PRECISION TOOLS • DIAL INDICATORS • STEEL TAPES • GROUND FLAT STOCK • HACKSAWS • HOLE SAWS • BAND SAWS • BAND KNIVES



For more information fill in page number on Inquiry Card, on page 197

# Thread Nomenclature and Definitions—1

## Applying To Screw Threads, Taps and Dies

ALLOWANCE. An allowance is an intentional difference in correlated dimensions of mating parts. It is the minimum clearance (positive allowance) or maximum interference (negative allowance) between such parts.

ANGLE OF THREAD. The angle included between the flanks of the thread, measured in an axial plane.

AXIS. The longitudinal central line through the screw or tap.

BACK TAPER. A slight axial relief on the thread of the tap which makes the pitch diameter of the thread near the shank somewhat smaller than that at the chamfered end. (See RELIEF)

BASE OF THREAD. The bottom section of a thread; the greatest section between the two adjacent roots.

BASIC. The theoretical or nominal standard size from which all variations are made. (See SIZE)

CHAMFER. The tapering of the end of the thread on a tap by cutting away and relieving the crest of the first few teeth to distribute the cutting action over several teeth. It also acts as a guide in starting the tap. When this tapering amounts to 8 to 10 threads, the tap is called a taper tap; when 3 to 5 threads, a plug tap; and with 1½ threads chamfer, a bottoming tap.

CHAMFER ANGLE. The angle formed between the chamfer and the axis of a tap. It is approximately 4½° for a taper tap, 9° for a plug tap, and 30° for a bottoming tap when threaded with American National Form of Thread.

CHAMFER RELIEF. On a tap, the gradual decrease in land height from cutting edge to heel on the chamfered portion, to provide clearance for the cutting action as the tap advances.

CLASSES OF THREADS. Distinguished from each other by the amount of tolerance or tolerance and allowance specified.

CORE DIAMETER. The diameter of an imaginary cylinder tangent to the deepest part of the flute.

CREST. The top surface joining the two flanks of a thread. The crest of an external thread is at its major diameter, while the crest of an internal thread is at its minor diameter.

CREST CLEARANCE. The space between the crest of a thread and the root of its component.

CUTTING EDGE. The leading side of the land in the direction of rotation for cutting and which does the actual cutting.

DEPTH OF THREAD. The distance between the crest and the base of the thread measured normal to the axis.

DRYSEAL. A fuel connection for both external and internal application designed for use where the assembled product must withstand high fluid or gas pressures without the use of a sealing compound or where a sealer is functionally objectionable.

FLANK. The surface of the thread, sometimes referred to as side of thread, which connects the crest with the root.

FLUTES. The longitudinal channels formed in a tap to create cutting edges on the thread profile and to provide chip spaces and cutting-fluid passages.

HEEL. The face of the tap land trailing the cutting edge during forward rotation.

HEIGHT OF THREAD. The distance between the crest and the base of thread measured normal to the axis.

HELIX ANGLE—FLUTE. Flutes of taps are sometimes cut helically instead of straight. This helix angle is the angle made by the flute with the axis of the tap. (Helical flutes are sometimes called spiral flutes.)

HELIX ANGLE—THREAD. The angle made by the helix of a thread at the pitch diameter with a plane perpendicular to the axis.

HOOK. The concave cutting face of a tap land between the crest and the root of thread.

INTERRUPTED THREAD. A tap having an odd number of lands, with every other tooth along the thread helix removed.

LAND. One of the threaded sections between the flutes on a tap.

LEAD. The distance a screw thread advances axially in one complete turn. On a single-thread screw or tap, the lead and pitch are identical. On a double-thread, the lead is twice the pitch; on a triple-thread, the lead is three times the pitch, etc.

LEAD ERROR. The amount the actual lead of the screw thread differs from the specified lead.

LEAD—DRUNKEN. Irregular advance of the thread helix, or lead. Usually called "drunken thread."

LENGTH OF ENGAGEMENT. The length of contact between two mating threaded parts measured axially.

LIMITS. The maximum and minimum sizes permissible for a specific dimension. (See ALLOWANCE and TOLERANCE.)

MAJOR DIAMETER. The largest diameter of a straight thread. On a taper thread, the largest diameter at any given plane normal to the axis. The term "major diameter" replaces the term "outside diameter" as applied to the thread of a screw or tap and also the term "full diameter" as applied to the thread of a nut or die.

MINOR DIAMETER. The smallest diameter of a straight thread. On a taper thread, the smallest diameter at any given plane normal to the axis. The term "minor diameter" replaces the terms "root diameter" and "core diameter" as applied to the thread of a screw or tap and also the term "inside diameter" as applied to the thread of a nut or die.

NUMBER OF THREADS. The number of threads in one inch of length.

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# Thread Nomenclature and Definitions (Continued)

PITCH. The distance from a point on a screw thread to a corresponding point on the next thread, measured parallel to the axis and on the same side of the axis. The pitch equals one divided by the number of threads per inch.

PITCH DIAMETER. On a straight screw thread, the diameter of an imaginary cylinder, the surface of which would pass through the threads at such points as to make equal the width of the threads and the width of the spaces cut by the surface of the cylinder. On a taper screw thread, the diameter, at a given distance from a reference plane perpendicular to the axis of an imaginary cone, the surface of which would pass through the threads at such points as to make equal the width of the threads and the width of the spaces cut by the surface of the cone.

PITCH LINE. A generator of the imaginary cylinder or cone specified in the definition of PITCH DIAMETER.

POINT DIAMETER. The diameter of the leading end of the chamfered section.

RAKE. On a tap, any deviation of a straight cutting face of the tooth from a radial line. Positive rake means that the crest of the cutting face is angularly advanced ahead of the balance of the face of the tooth. Negative rake means that the same point is angularly behind the balance of the cutting face of the tooth. Zero rake means that the cutting face is directly on the center line.

RELIEF—RADIAL. The clearance produced by removal of metal from behind the cutting edge. Taps should have the chamfer relieved and should have back taper, but may or may not have relief in the angle and on the major diameter of the threads. When the thread angle is relieved from heel to cutting edge, the tap is said to have "eccentric" relief. If relieved from heel for only a portion of land width (usually 2/3) the tap is said to have "con-eccentric" relief. (See BACK TAPER.)

ROOT. The bottom surface joing the flanks of two adjacent threads. The root of an external thread is at its minor diameter, while the root of an internal thread is at its major diameter.

SCREW THREAD. A ridge of uniform section in the form of a helix on the external or internal surface of a cylinder, or in the form of a conical spiral on the external or internal surface of a cone or frustum of a cone. A thread formed on a cylinder is known as a "straight" or "parallel" thread, to distinguish it from a "taper" thread which is formed on a cone or frustum of a cone. All left-hand threads are designated LH.

SPIRAL POINT. A supplementary fluting, cut at an angle to the main fluting, in the cutting face of the land. It is slightly longer than the chamfer on the tap and in the opposite hand to that of cutting rotation.

SIZE—ACTUAL. The measured size of that dimension on an individual part.

SIZE—BASIC. The theoretical size from which the limits of size for that dimension are derived by the application of the allowance and tolerances.

SIZE—NOMINAL. The designation used for general identification.

THREAD—SINGLE. A thread in which the lead is equal to the pitch.

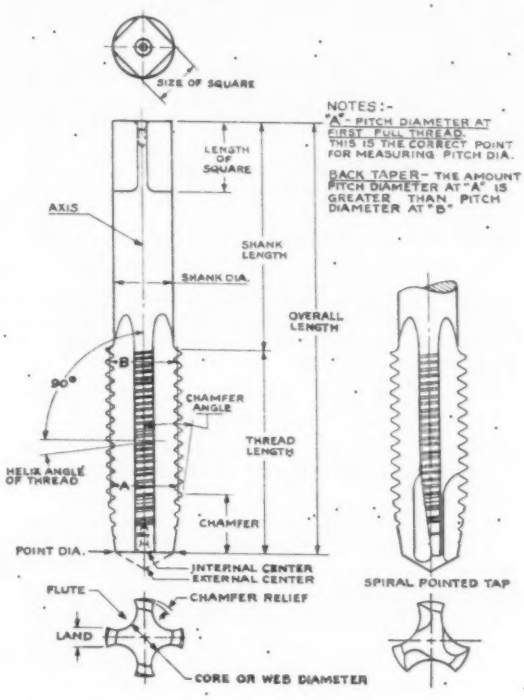
THREAD—MULTIPLE. A thread in which the lead is an integral multiple of the pitch. On a double thread, the lead is equal to twice the pitch; on a triple thread the lead is equal to three times the pitch, etc. Such threads have starting points relative to their multiple equally spaced around their circumference. For example, a double thread has two starting points 180° apart, a triple thread has three 120° apart, etc.

THREAD—DRUNKEN. A thread in which the advance of the thread helix is irregular.

TOLERANCE. The amount of variation permitted in any dimension. Tolerance may be expressed as plus, minus, or both. A total tolerance is the sum of a plus and minus tolerance. Complete tolerances on threads include those for major diameter, minor diameter, pitch diameter, lead, half angle, and full angle. (See ALLOWANCE and LIMITS.)

TRUNCATION—CREST. The distance, measured perpendicular to the axis, between the sharp crest (or crest apex) and the cylinder or cone which bounds the crest.

TRUNCATION—ROOT. The distance, measured perpendicular to the axis, between the sharp root (or root apex) and the cylinder or cone which bounds the root.

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CTW

Continental Counterbores may be purchased individually or in sets. Selection of three sets available.

# After the heaviest cuts—they disengage with a twist of the wrist

Continental Counterbores are designed so that cutting torque produces compression rather than shearing stresses. This counterbore never binds—you get quick, easy disengagement after all cutting operations. Anti-wedging action saves time and tools.

Continental Counterbores have double driving lugs on the cutters which engage double abutments in the holders, making a single powerful tool out of the cutter and holder. Double bearings, one above and one below the lugs and close to the cutting edge, guarantee rigid alignment of holder and cutter.

For more information or literature on Continental Counterbores, call your local Ex-Cell-O Representative or write to Continental Tool Works in Detroit.

Continental **TOOL WORKS**

DIVISION OF

EX-CELL-O CORPORATION • DETROIT 32, MICHIGAN

56-61

one operation has been introduced by the Lassy Tool Co., Plainville, Conn.

The compensating jaws clamp each individual work-piece with equal pressure, even though the pieces may vary in size by as much as 1/32 inch. The springless clamping action is positive and constant, and may be controlled to suit the work-pieces or operation.

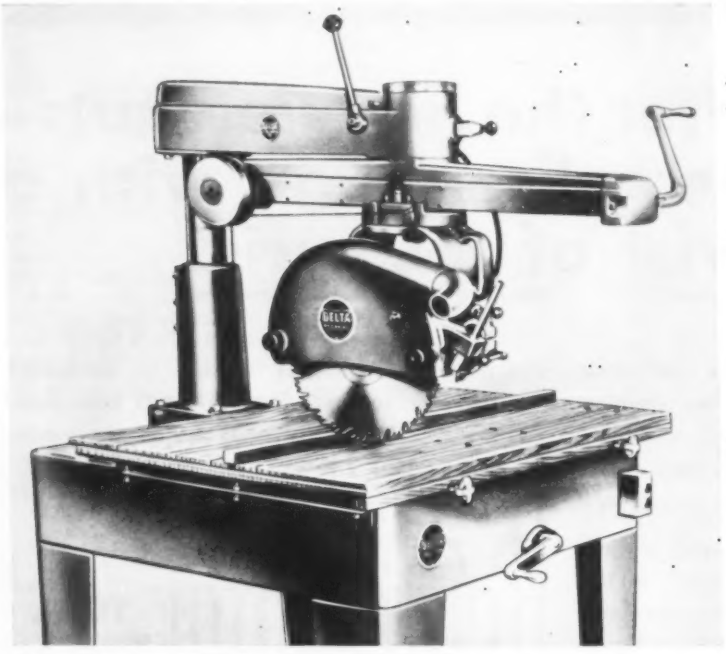
The model shown uses a conventional screw lock, but the fixtures can be adapted for either air or hydraulic clamping or locking, and can be used vertically or horizontally. Model GF-2 holds from four pieces (2 inches in diameter) up to 128, 1/16 inch in diameter. Jaws are available for flat work which are designed to hold pieces of various widths up to 8 inches in length.

**Circle Item 155 on postcard, page 197**

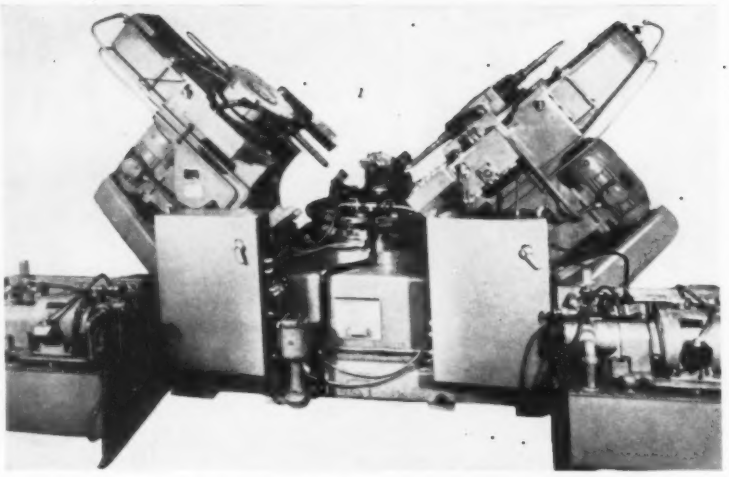
## Delta Radial Saw

A radial saw with a chain-feed control that gives a constant, steady feed for cutting non-ferrous metals has been introduced by the Delta Power Tool Division, Rockwell Mfg. Co., Pittsburgh, Pa. A precision index plunger permits the operator of this machine to make quick, positive settings at the most-used angles. Accurate settings at all other angles are assured by a positive clamping device. A safety return is also incorporated in this model. The saw may be used with 16-, 18-, or 20-inch blades, and is available with a 3-, 5-, or 7·1/2-hp motor.

**Circle Item 156 on postcard, page 197**



Delta radial saw that can be equipped with chain-feed control for cutting non-ferrous metals



Burgmaster special machine built to process aluminum cylinder heads

## Special Machines Built from Standard Components

The Burg Tool Manufacturing Co., Gardena, Calif., is building six- and eight-spindle automatic hydraulic turret drills equipped to perform a series of operations including drilling, boring, counterboring, countersinking, tapping, reaming, multiple forming, and similar work. The spindles are automatically indexed and controlled. They have their own preselected speeds and feeds and automatic precision depth stops.

Feeds can be quickly adjusted to suit the individual job. Any sequence of operations can be performed automatically, including skip indexing, or duplicate and repeat individual operations. All spindles have automatic rapid approach and return. The button control panel simplifies operation and the controls can be easily set. Rapid change-over from one part to another is accomplished simply by changing tools and fixtures.

The machine illustrated has a fixture built on the table of a standard four-position power-indexing table. Only two positions are utilized, which permits the operator to load one forged-aluminum cylinder head while work is in progress in the second station. The part is then automatically indexed, which eliminates loss of machine time for loading and unloading.

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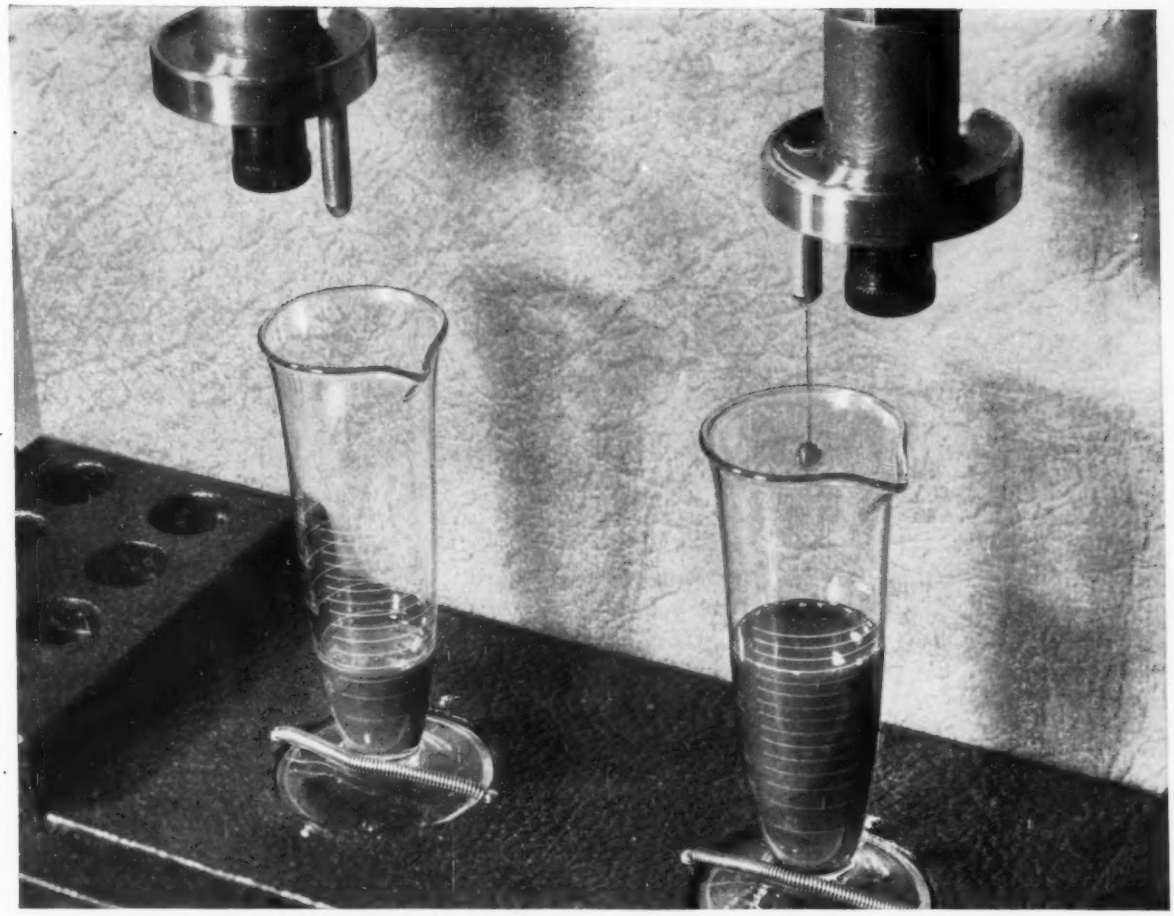

The oils collecting in these graduates are being forced, at 100 psi, through two sintered bronze bearings. Although each oil has the same viscosity, the Suntac on the left is leaking *only one quarter as much as* the straight oil on the right.

# Desk-top demonstration proves that SUNTAC HYDRAULIC OILS can cut your oil losses . . . up to 75%

Suntac® oils are competitive in price, competitive in quality, *and unique in their ability to reduce oil leakage without costly shutdowns.*

Suntac oils are high-quality, exceptionally stable mineral oils especially compounded to reduce leakage. Experience proves that they give longer pump and seal life with higher over-all operating efficiency.

See for yourself how a Suntac oil can cut your oil costs. A simple desk-top demonstration will show you how.

Ask your Sun man to show you how others have reduced oil consumption, or write to Dept. M-7.

Industrial Products Department

**SUN OIL COMPANY, Phila. 3, Pa.**

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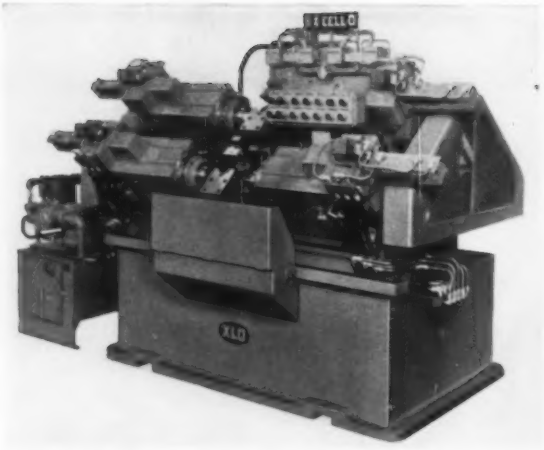


Fig. 1. Ex-Cell-O machine equipped for rapid processing of sleeve yokes

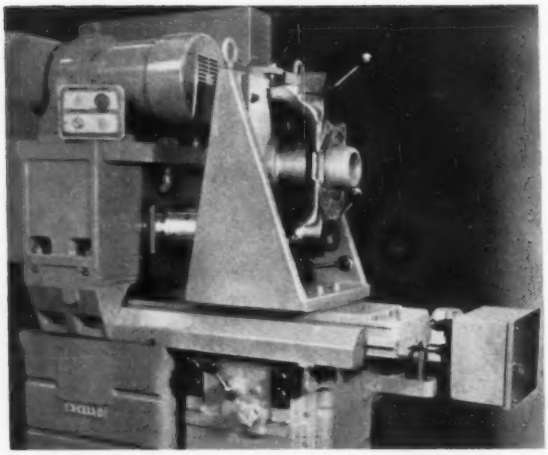


Fig. 2. Precision boring machine built and tooled by Ex-Cell-O Corporation

## Ex-Cell-O Machines for Processing Sleeve Yokes and Clutch Housings

The Ex-Cello-O Corporation, Detroit, Mich., recently built a two-way, four-spindle machine, Fig. 1, which grooves and counterbores universal sleeve yokes at the rate of 385 per hour. Both ends of one part are machined simultaneously in one station while the other station is being loaded. Manual loading is followed by pneumatic clamping. The fixture is designed for quick change-over and will accept a large range of similar parts.

The small Ex-Cello-O precision boring machine, Fig. 2, is designed to meet small-scale production requirements. The component, Fig. 3, machined with this equipment, is a heavy cast-iron clutch housing for a medium-size truck. The operation consists of facing and precision boring the housing for mounting the starter motor, roughing and finishing operations being required in one machining cycle. The ruggedly constructed fixture utilizes cam-actuated, hand-clamping, and dowel-pin location of the work.

**Circle Item 158 on postcard, page 197**

Fig. 3. Clutch housing processed on machine shown in Fig. 2

## Micrometer Head for Electronic Equipment

A micrometer head designated No. T465, designed for use in electronic equipment requiring ultra-fine adjustment and for machine tools, fixtures, special gages, and tools where micrometer accuracy in settings and adjustment is required, has been announced by the L. S. Starrett Co., Athol, Mass. This micrometer head reads directly in ten-thousandths of an inch and has a 1-inch range. An important feature is a new constant-pressure nut (patents pending) which makes possible a wide range of tension adjustment from light to heavy, to suit requirements. The thimble is 2 1/8 inches in diameter with widely spaced direct-reading graduations.

Other precision features are: quick-reading graduations with every thousandth numbered; no-glare satin chrome finish on thimble and sleeve; one-piece hardened spindle with threads ground from the solid and stabilized; and Hi-Micro mirror-lapped finish on end of spindle.

Over-all length at zero is 4 3/8 inches; length of clamping surface, 9/16 inch; diameter, 1 inch; and length from face of clamping surface to end of spindle at zero, approximately 1 3/8 inch.

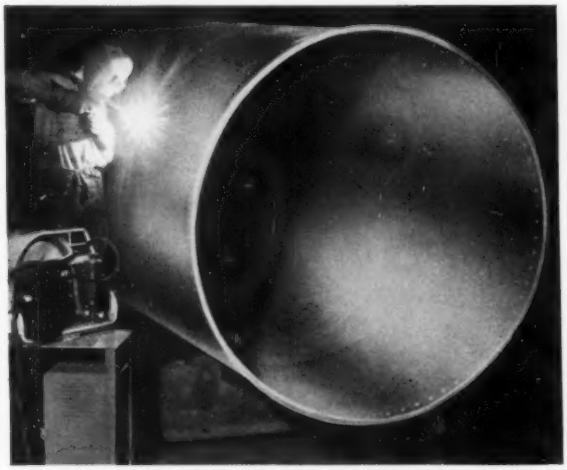
Starrett micrometer head designed for machine tools and electronic equipment

**Circle Item 159 on postcard, page 197**

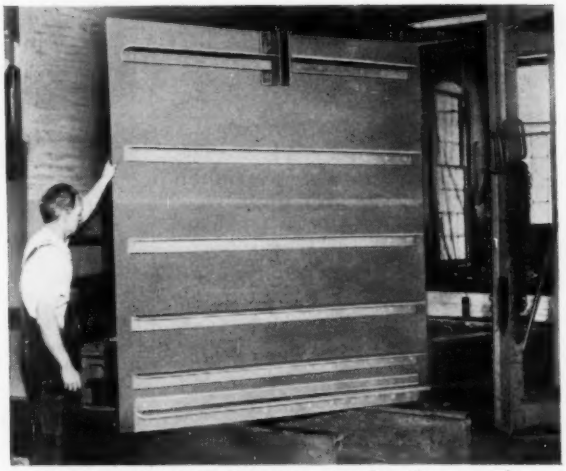
*(This section continued on page 216)*

# CUT CORROSION LOSSES

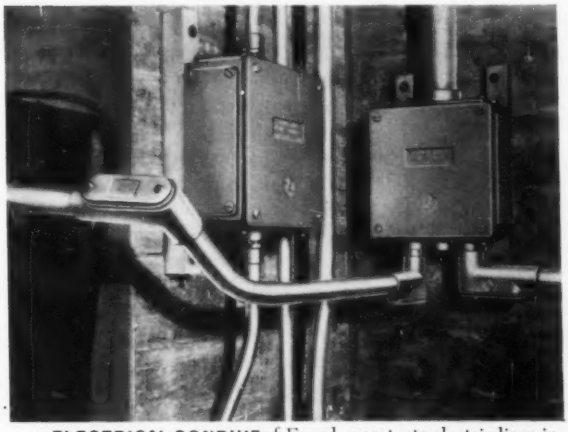
## Get unusual corrosion resistance, plus high strength, toughness, weldability, and easy fabrication with Everdur,® Anaconda copper-silicon alloys



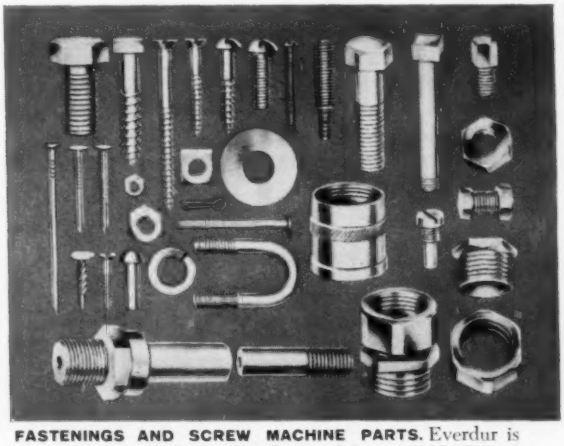
**TANKS AND INDUSTRIAL EQUIPMENT** requiring a combination of high strength, toughness and resistance to corrosion. Hot water storage heaters and tanks, unfired pressure vessels of Everdur are readily fabricated by welding.



**IN WATER AND WASTE SYSTEMS,** Everdur alloys provide easy fabrication and long service in a wide variety of jobs—from gates on to bolts and nuts. Their high strength makes possible lightweight, built-up assemblies of wrought metal.



**ELECTRICAL CONDUIT** of Everdur protects electric lines in corrosive environments, withstands vibration and abrasion—at oil refineries, in underwater tunnels (above), chemical plants. Made in two wall thicknesses—R.C. and E.M.T.



**FASTENINGS AND SCREW MACHINE PARTS.** Everdur is available in forms for hot heading and forging of bolts and accessories, severe cold-working operations for bolts and screws—and as free-cutting rod for screw machine products.

Whenever you have a tough problem calling for high strength with immunity to rust, and corrosion resistance equivalent to pure copper, consider an Everdur alloy. It may save you a lot of trouble and money. For details on properties and applications of Everdur alloys, write for Publication E-5. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5644

**EVERDUR**

**COPPER-SILICON ALLOYS**

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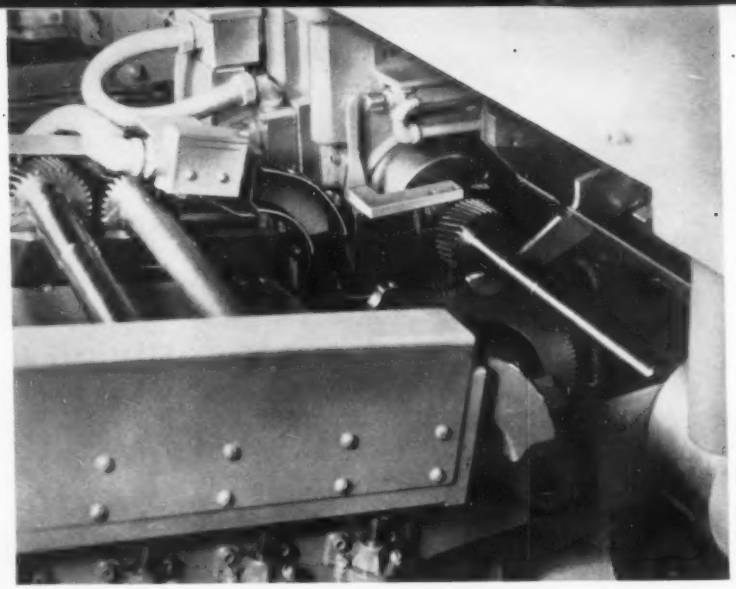
## Automatic Loading and Unloading Devices

Faster and more economical finishing of geared shafts is possible with new automatic parts-loading and unloading devices developed by the Michigan Tool Co., Detroit, Mich. These devices are designed to work as a unit with their full line of universal rotary gear-finishing machines.

In one automotive application on the rear sun gear of an automatic transmission, the devices increased output to 120 parts per hour at 80 per cent efficiency. The illustration shows a close-up of the automatic loading unit.



Close-up of automatic loading device developed by Michigan Tool Co. for its gear-finishing machines

In operation, the geared shafts are manually placed against air-operated escapement fingers on both sides of a gravity chute. A bank of five air cylinders on each side of the loading fixtures (three can be seen in the lower left corner of the illustration) actuates the escapement fingers. This provides positive (one piece at a time) flow of parts to loading shuttle.

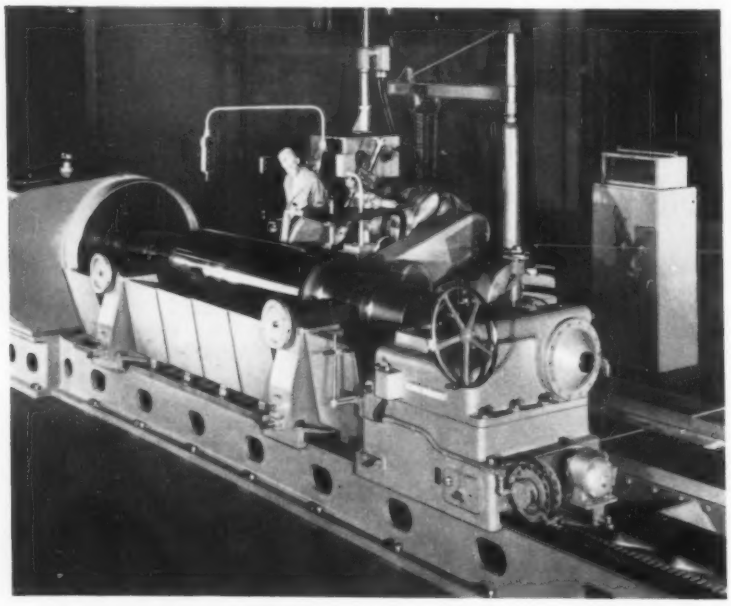
As each part is released from the last slide position it rolls through an open-side curved track to the loading shuttle. This pneumatically operated device driven from a 2 1/2-inch bore, 5 3/8-inch stroke cylinder, accepts only one part at a time. The shuttle has two arms, one to cradle each shaft end. Both arms carry the gear to the shaving position where it is "picked up" by air-operated centers.

After finishing, two arms of the unloader come up and cradle the parts as the centers are withdrawn. The unloader arms continue this upward movement to an angle sufficient to cause the part to roll to a stop close to the unloading conveyor. On the return (downward) movement of the arms the shaft is "caught" by side rails of the conveyor as the pick-up arms continue to their normal position. The part is then in position to be moved by the conveyor.

Circle Item 160 on postcard, page 197

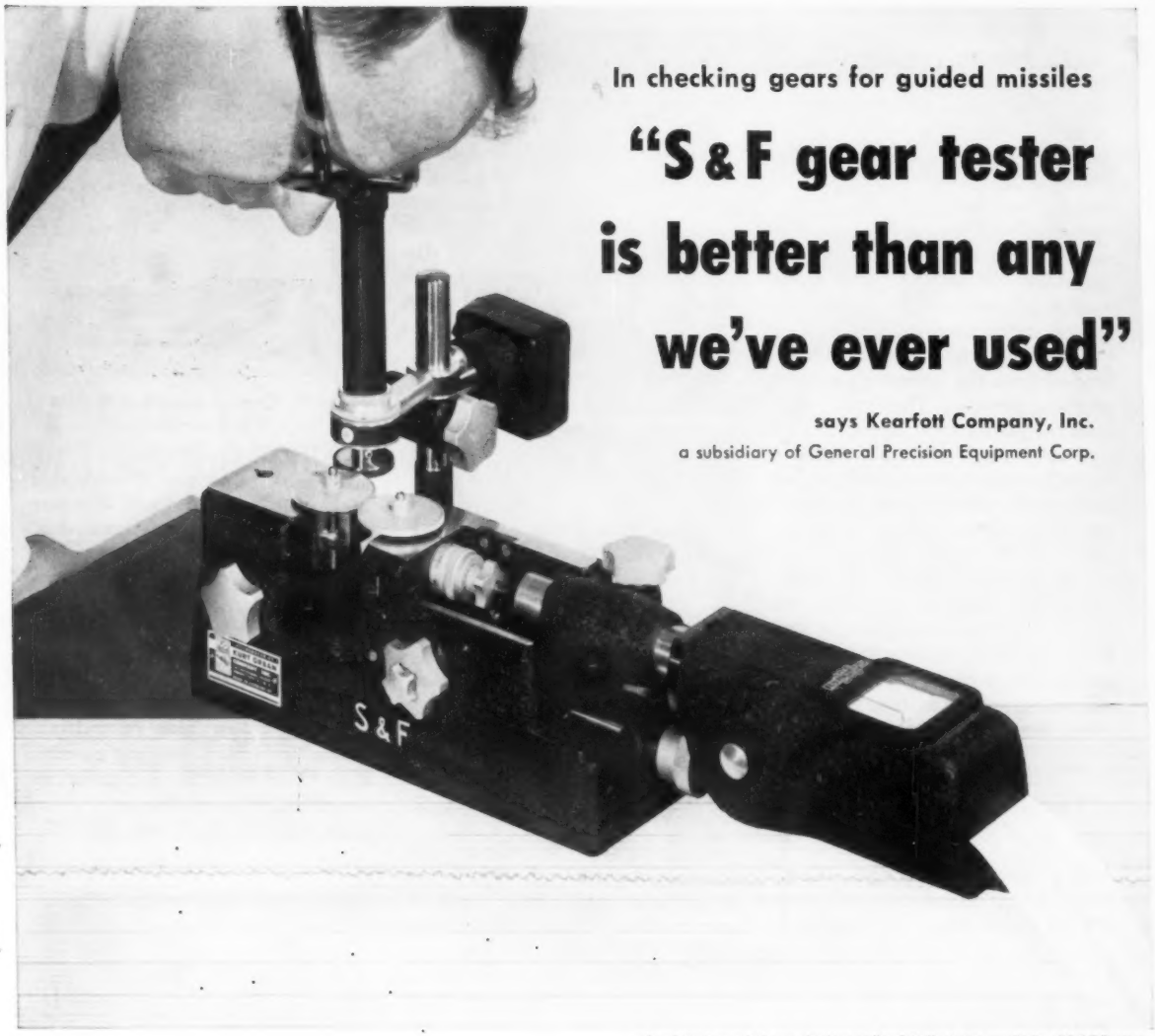
## Cincinnati Filmatic Roll-Grinding Machines

Four sizes of traveling-wheel-head roll-grinding machines, 36-, 44-, 50-, and 60-inch, are now being built by Cincinnati Grinders Inc., Cincinnati, Ohio. The 36-inch size is available in 10- to 20-foot lengths, and the others in 12- to 24-foot lengths. The grinding wheel spindle runs on Filmatic bearings which automatically adjust themselves to suit the rate of stock removal and aid in producing a fine finish on the rolls. Carriage traverse is infinitely variable from 3/4 inch to 75 inches per minute. It is electronically controlled, and driven from a direct-current motor through a rack and pinion. Dwell or tarry at reversal is adjustable from 0 to 12 seconds. Rapid, automatic deceleration before reversal eliminates shock.



Cincinnati traveling wheel-head roll-grinding machine

All controls are easily reached from the operator's platform on the carriage. These include automatic balancing lever (when so equipped), hydraulic truing controls, size-adjustment handwheel, pendant control, load meter, etc. An independent rapid traverse push-button, when released, in-




In checking gears for guided missiles

# "S & F gear tester is better than any we've ever used"

says Kearfott Company, Inc.
a subsidiary of General Precision Equipment Corp.

Graphotest record of gear checking at Kearfott illustrates sensitivity of S & F Testers.

## There's no gear tester as accurate as the S & F...

# guaranteed to repeat within .00001"

To insure the precision control and navigation of guided missiles and aircraft, Kearfott gears *must* be accurate within .00025". Kearfott technicians use seven S & F testers to check these gears and here's what they say about them: "Excellent for accuracy and repeatability—better than any tester used previously. They require minimum maintenance, are economical to buy and use."

That's why there are over 500 S & F testers in some 316 plants that take their gear checking seriously. They've changed over to S & F to make sure that the gears they make—or buy—are as accurate as they're supposed to be.

Ask us to show you why the S & F is revolutionizing gear-checking. Or talk to S & F users near you; we'll send you their names.

KO CO., INC. PRECISION MACHINERY

**KURT ORBAN**

**COMPANY, INC.**

42 Exchange Place, Jersey City 2, New Jersey

For more information fill in page number on Inquiry Card, on page 197

stantly returns carriage traverse speed to the selected grinding rate. The roll-cambering mechanism, located at the rear of the wheel-head unit, operates on the tilting wheel-head principle. This mechanism incorporates a taper grinding unit, engaged by a lever next to the cambering unit. An interlock device prevents these two mechanisms from being engaged at the same time.

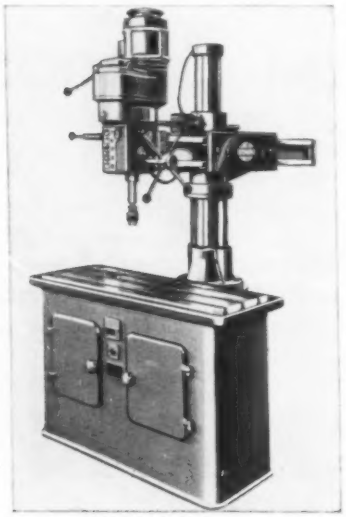
Grinding wheel truing is controlled from the operator's normal working position. The truing unit is of the profile type, hydraulically operated and equipped with a two-direction rate-control valve and profile booster lever. A wheel-speed control device is incorporated in the truing unit. As the wheel becomes smaller, the diamond bar must be advanced for truing, and the speed-control device (rheostat) automatically increases the wheel speed to retain efficient grinding action.

**Circle Item 161 on postcard, page 197**

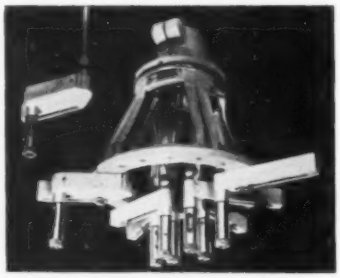
## Donau Radial Drilling Machine

The Cosa Corporation, New York City, is introducing a Donau DB 25 radial type machine with a capacity for drilling holes up to 1 inch in diameter in steel, and tapping holes up to 7/8 inch in diameter. A lever operated by one hand controls both horizontal and radial movements as well as all clamping operations, while push-buttons operated by the other hand control vertical movements of the radial arm. Four different speed ranges, from 60 to 1700 rpm, are available with a two-speed 1/3-hp motor. The standard distance from spindle center to column face is 35 1/2 inches but on special order can be increased to 39 1/2 inches.

**Circle Item 162 on postcard, page 197**



Radial drilling machine introduced by Cosa Corporation



Thriftmaster drill head with extension-bracket assembly

## Extension Spindle-Bracket

An extension spindle-bracket assembly for use with its full line of universal-joint drill heads is now available from the Thriftmaster Products Corporation, Lancaster, Pa. This equipment provides a 4 1/8-inch extension of the maximum adjustment and permits drilling under and beyond the flange of the drill-head body. The assemblies are precision machined for use with jig-bored spindle-locating templates. The illustration shows an 8-spindle drill head with one extension-bracket assembly in place and one removed.

**Circle Item 163 on postcard, page 197**

## Brown & Sharpe End-Mills

The Cutting Tool Division, Brown & Sharpe Mfg. Co., Providence, R. I., has just added fifteen two-flute end-mills of the straight-flute type, similar to the one shown in Fig. 1, to its more than 3200 available standard tools. Four single-end end-mills from 7/8 inch to 1 1/4 inches in diameter, and eleven double-end end-mills from 1/8- through 1-inch

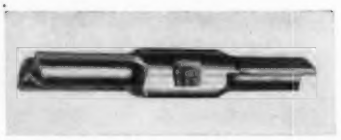


Fig. 1. Brown & Sharpe two-flute end-mill

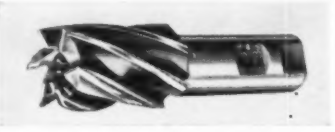


Fig. 2. One of seventy-nine new B & S end-mills

sizes with other recent additions make the B & S end-mill line one of the most complete available. All two-flute end-mills are center-cutting, and are engineered to give extreme accuracy in plunge-cutting and peripheral slotting.

Seventy-nine sizes of square-end end-mills, of the design shown in Fig. 2, have also been added to their line of cutters. These end-mills, ranging in size from 1/4 inch to 2 inches in diameter, are available.

**Circle Item 164 on postcard, page 197**

Self-locking screw manufactured by the Standard Pressed Steel Co.

## Unbrako Self-Locking Socket Screw

A complete line of Unbrako self-locking socket screw products have been announced by Standard Pressed Steel Co., Jenkintown, Pa. Made self-locking by the Nylok (nylon) insert seated in a hole drilled part way into their threaded section, these Unbrako screw products, like the cap-screw illustrated, hold tight, and stay tight under severe shock and vibration.

**Circle Item 165 on postcard, page 197**

HOW TIMES AND TOOLS HAVE CHANGED!

# IT COST US A NEW CP UNIVERSAL ELECTRIC

TO RETIRE THIS 50 YEAR OLD VETERAN

The CP Electric Drill made in 1908 was still on the job until we swapped a brand new CP tool just to get our hands on it. Only the styling has changed. Today the ability of CP Hicycle, Super Cycle and Universal Electrics to perform for a half-century or more remains unchanged! Note how the new CP 903-R Electric Impact Wrench keeps in tune with the times . . . 2″ profile to get into the tight spots dictated to by modern space-saving designs . . . the centered pistol grip with reverse switch in handle for simple, one-hand operation. And the CP 903-R delivers 2000 blows a minute — has built-in bonus capacity, rated for ⅜″ bolt size, handles ⅝″ readily.

**Chicago Pneumatic**

8 East 44th Street, New York 17, New York

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

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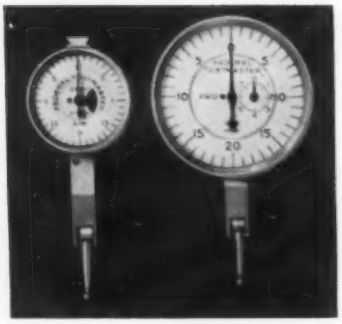


### Testmaster Indicators for High-Precision Work

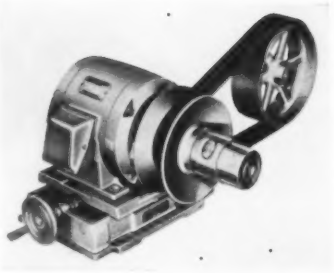
Testmaster Swiss-made test indicators manufactured to the highest standard of precision, now being marketed by Federal Products Corporation, Providence, R. I. There are eight models in the series; four have 0.0001-inch graduations with a range of 0.032 inch, and four have 0.0005-inch graduations with a range of 0.060 inch. All have satin-chrome finish and are made in both the horizontal and perpendicular models. Two sizes of dials are available in both styles—1-inch and 1 1/2-inch.

Circle Item 166 on postcard, page 197

### Carbide-Insert Tool-Holder

Positive rake tool-holder added to the line of carbide-insert toolholders made by the Armstrong Bros. Tool Co., Chicago, Ill. It is made in styles for holding triangular or square inserts, and in shank sizes for use in conventional and open-side toolposts. Each tool is provided with a wrench. Inserts and chip breakers are available separately.

Circle Item 167 on postcard, page 197



### Reeves Vari-Speed Motor Pulley

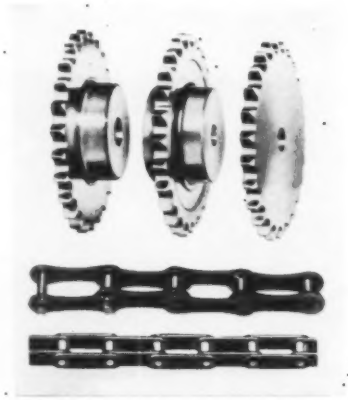
Motor with one of a completely redesigned line of variable-speed motor pulleys announced by the Reeves Pulley Co., Columbus, Ind., a division of Reliance Electric and Engineering Co. Called the 90 Series Vari-Speed motor pulleys, the units in this line are designed for applications from 1/2 through 15 hp, with up to 4 to 1 ratios of speed variation. Simplicity, precision, and lower cost are advantages claimed for these units.

Circle Item 169 on postcard, page 197

### Aircomatic Welding Gun and Control Cabinet

"MIGet" Aircomatic welding gun and control cabinet brought out by the Air Reduction Sales Co., a Division of Air Reduction Co., Inc., New York City. This metal arc inert-gas welding tool is designed for short-length welds in hard-to-get-at places. Drive rolls and wire supply are contained in the gun. The wire-feeding speed ranges up to 900 inches per minute. The gun handles 0.030-, 0.035-, 3/64- and 1/16-inch aluminum and 0.030-, 0.035- and 0.045-inch hard wires. Typical applications include: extruded aluminum shapes, highway signs, aluminum furniture, radar screens, antennas, and various brackets. The control cabinet is 11 by 22 by 4 inches deep, and weighs 17 pounds. Without wire supply, the gun weighs about 3 pounds. The welding power source must be a direct-current machine.

Circle Item 168 on postcard, page 197



### Boston Gear Chain Drives

Steel and iron sprockets for 1 1/2-, 1 3/4-, and 2-inch pitch chain announced by Boston Gear Works, Quincy, Mass. These sizes have been added in the heavier-duty size range and include plate, single-hub, and double-hub types. Steel-plate sprockets (Type A), and sprockets with hub (Type B), for 1/2- to 1 1/4-inch pitch chain are also available in the lighter duty range. Other additions include double-pitch roller

chain in the three commonly used types. Drive and agricultural series are available in 1-, 1 1/4-, and 1 1/2-inch pitch. Conveyor series may also be had in this range as well as in 2-inch pitch.

Circle Item 170 on postcard, page 197

## Starrett Moderately Priced Micrometer

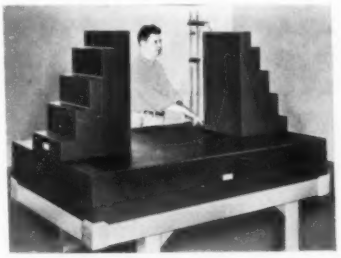
Outside micrometer caliper of 1-inch capacity designed to combine strength, rigidity, and lightness with fine precision features offered at moderate price by the

L. S. Starrett Co., Athol, Mass. Frame of this No. 436 Series outside micrometer caliper is forged and ribbed for extra strength, and tapers to the anvil to permit use in narrow slots and tight places. Thimble and sleeve have a hard, long-wearing, multiple-plate, satin-chrome finish. Also available with carbide faces. Decimal equivalents of 8ths, 16ths, and 64ths inch are conveniently placed on the thimble.

Circle Item 171 on postcard, page 197

## Large Granite Angle-Plates

Extremely large, black granite angle-plates, announced by Rahn Granite Surface Plate Co., Dayton, Ohio. Illustrated is a matched pair having bases 18 by 18 inches, with 30-inch heights, and weighing 1 ton. The tolerance for

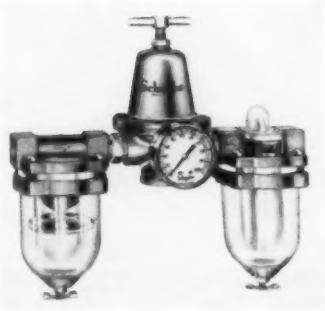


squareness is 0.00012 inch in the 30-inch height. This averages only 4 millionths of an inch per inch of height, which is less than 1 second of arc.

Circle Item 172 on postcard, page 197

## Device for Regulating, Filtering, and Lubricating Air Lines

"Lub-Air-Ator" designed to filter air, regulate pressure, and lubricate air lines, available from A. Schrader's Son, Division of Scovill Mfg. Co., Inc., Brooklyn, N. Y. This compact device has been developed to improve the efficiency of air lines which serve controls,

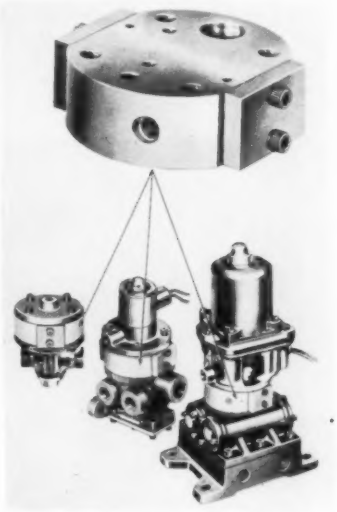


instruments, or air tools. It has no moving parts and can be easily serviced without disturbing pipe connections.

Circle Item 174 on postcard, page 197

## Ross Double-Stroke Adapter for Skyline Valves

Double-stroke air-index adapter developed by Ross Operating Valve Co., Detroit, Mich., to convert any of its long-life Skyline



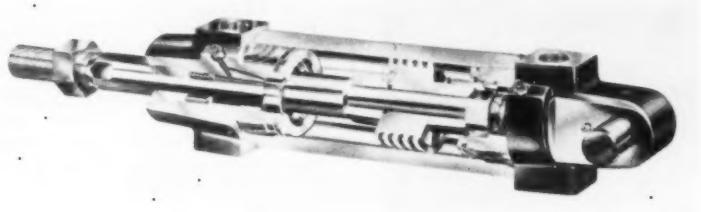
series valves to momentary action service. Adapter can be inserted between any Ross Skyline series head and body combination, as shown in the lower views of the illustration. When used in a single solenoid valve, it causes the valve to reverse and remain in that position each time the solenoid is energized. Used with an air-operated valve, the valve reverses and remains fixed with each pilot air impulse.

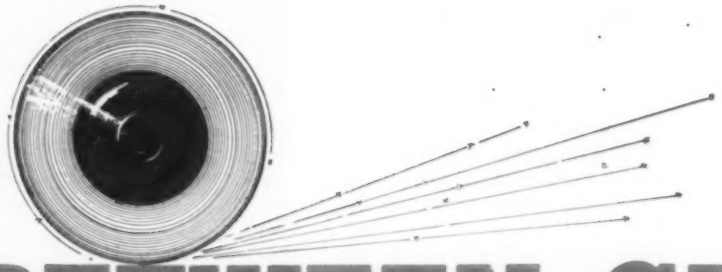
Circle Item 175 on postcard, page 197

## High-Pressure Hydraulic Cylinder

Spacemaker high-pressure hydraulic cylinder known as the T-J, with operating pressures of 1000, 2000, and 3000 pounds per square inch announced by the Tomkins-Johnson Co., Jackson, Mich. This hydraulic cylinder is available in a cushioned or non-cushioned style with forged-steel heads, self-aligning adjustable cushion, high-pressure piston-ring construction with three types of oversized ports, and extra-long rod guide bearing—all standard equipment, at no extra cost.

Circle Item 173 on postcard, page 197





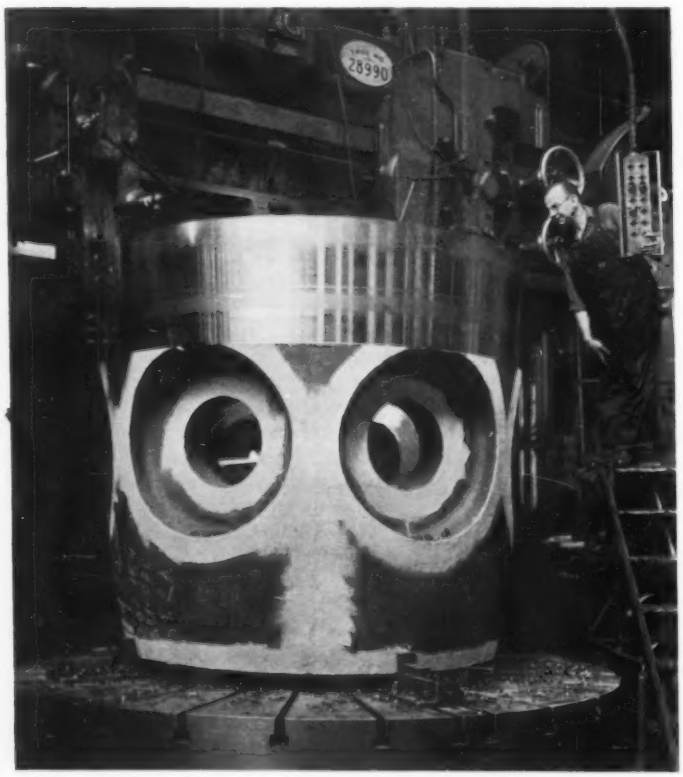
By E. S. Salichs

# BETWEEN GRINDS

## Now We Say It Isn't So

A great big fat zero inadvertently dropped has caused some consternation, and rightly so, at the Illinois Gear & Machine Co., the result of an item which appeared in our News of the Industry columns, page 234, in May. This Chicago company had announced the completion of the plant expansion program for its South Works. And we quote us: "The principal feature of this program is the heavy-machinery building, 300 feet long and 8 feet wide, with railroad tracks through the center." The new building is *80* feet wide, and we hope that our readers, knowing a thing or two about measurement, spotted the incorrect dimension as an editorial error, and not as a bid for Believe-It-or-Not.

MISS ALICE, A CHARMER—Actually not the girl friend of the witch doctor, this weirdy is a hydraulic-turbine runner hub being manufactured at the West Allis Works of the Allis-Chalmers Mfg. Co., the markings that make up the eyes and nose indicating how much metal has to be cut away. The hub is for a unit destined for duty at the St. Lawrence Power Dam.




## Magna Cum Lode

Sterling silver diplomas, symbolic of graduation from the Colorado School of Mines, were awarded to graduates at the recent commencement exercises of this mineral engineering college. We hope these graduates really do acquire polish with and for their diplomas.

## Tank Larger, Turnips, Too

A giant crystallizer, towering higher than a seven-story building and believed to be the world's largest, was recently erected in Hopewell, Va. The stainless-steel plates for the crystallizer were supplied by the Allegheny Ludlum Steel Corporation, and are of Type 316 stainless steel. The picture sent with this company release reminded us of one in the news, that of a European apartment house built around a water tower, thus obscuring an eyesore. Inadvisable in this case, since crystallizers are used for making farm fertilizer.

## Let's All Whistle for the Bristle

Two years ago, our Government offered to sell 2,000,000 pounds of hog bristles (for paint brushes), leftovers from the nation's "storm pantry," according to *National Chamber Washington Report,* but still has 1,300,000 pounds on hand. Really stuck with surplus.

## The Needle Point of View

A housewife living in Bethlehem, Pa., has created beautiful needlepoint tapestries depicting the steel industry, according to *Steelways.* The lady, Mrs. Mildred T. Johnstone, has received many letters from wives of steelworkers thanking her for giving them a fresh and exciting way to look at the steel mill complex.

# HARD GEAR HONING

## CURRENT RESULTS

**The following records are taken from current gear honing operations to show how some of the troublesome hazards of gear manufacturing are overcome by honing.**

### WHAT HONING ACCOMPLISHED

**GEAR "A"**

A lead error of .0008" was reduced to .0001"

**GEAR "B"**

Runout was improved .0020"

**GEAR "C"**

Notable improvement in both surface finish and in amount of tooth kickout

**GEAR "D"**

Variation in involute form improved .0002"

**GEAR "E"**

Size over pins reduced .004" and all nicks removed. Essentially a salvage job

### THESE ARE THE GEARS BEING HONED

| Gear | No. Teeth | Pitch Dia. | Rockwell "C" | Stock Removed | TIME | |
|---|---|---|---|---|---|---|
| | | | | | Honing | Floor to Floor |
| "A" INTERNAL | 83 | 5.7832 | 58-63 | .0015 | 40 sec. | 70 sec. |
| "B" PLANET PINION | 15 | .790 | 56 | .0005 | 27 sec. | 31 sec. |
| "C" REAR SUN GEAR | 45 | 2.3726 | 54 | .0006 | 30 sec. | 34 sec. |
| "D" REAR SUN GEAR | 45 | 2.508 | 58 | .001 | 24 sec. | 30 sec. |
| "E" SPUR GEAR | 46 | 6.000 | 60 | .004 | | 3 min. 25 sec. |

NOTE: Hone Life, Gear "B"—6000 to 8500 pieces
Gear "C"—3000 to 4000 pieces

Write for Bulletin H-57-2

SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING, GEAR HONING AND ELLIPTOID

**NATIONAL BROACH & MACHINE CO.**

5600 ST. JEAN • DETROIT 13, MICHIGAN

8098

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

For more information fill in page number on Inquiry Card, on page 197

# News OF THE INDUSTRY

## California

HUFFORD CORPORATION, a subsidiary of THE SIEGLER CORPORATION, El Segundo, Calif., announces the election of DAN W. BURNS as president. Mr. Burns, previously vice-president and general manager

Dan W. Burns, president, Hufford Corporation

of Hufford, succeeds MERRILL L. BENGTSON. Mr. Bengtson is chairman of the executive management committee of Siegler, and a director of the parent corporation.

## Illinois and Indiana

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., has announced a number of sales appointments at its Pittsburgh steel service plant. A. PHILIP BRENDEL was named manager of reinforcing products sales, replacing JOHN H. VAN HORNE, who, in turn, has been transferred to the company's Los Angeles plant. The new manager of the general order department is DAVID W. WOLFF, succeeding GENE W. SULLENGER, who has become a field sales representative. ROBERT E. MINSER of the general order department has also been appointed to a sales district post.

SILAS S. CATHCART was elected vice-president of Illinois Tool Works, Chicago, Ill. He will continue as general manager of Illinois Tool's Fastex Division, Des Plaines, Ill.

EDWARD V. ALLEN has been transferred to San Francisco from the Buffalo area to be the sales and service representative for the Chicago-Latrobe Twist Drill Works, Chicago, Ill., in the northern California and Nevada territory.

STROM STEEL BALL CO., Cicero, Ill., has announced the transferring of its entire executive offices and plant facilities, formerly located at 1850 South 54th Ave., Cicero, Ill., to a completely modern new plant located in Erwin, Tenn.

ROBERT J. HIGLEY has been named vice-president in charge of planning for Hupp Aviation Co., subsidiary of Hupp Corporation, Chicago, Ill. Mr. Higley was promoted from the post of controller.

N. M. (DUTCH) FORSYTHE was elected president of the National Automatic Tool Co., Inc., Richmond, Ind. Mr. Forsythe has been vice-president and general manager of "Natco" since 1954. HARRY W. BOCKHOFF, formerly president and chairman of the board, continues as chairman.

THOR POWER TOOL CO., Chicago, Ill., has elected JOHN A. MCGUIRE an executive vice-president. JAMES A. LIND, currently treasurer, and vice-president, was elected a director of the company.

## Michigan

CHRYSLER CORPORATION, Stamping Division, Detroit, Mich., has announced new assignments for three plant managers: ROY BLASIOLA, formerly manager of the Mack Ave. stamping plant in Detroit, to be manager of the Ohio stamping plant at Twinsburg, Ohio; WILFRED T. HANLON, formerly manager of the Ohio stamping plant, to be manager of the Outer Drive stamping plant; WALTER B. CONNOLLY, formerly manager of the Outer Drive stamping plant in Detroit, to be manager of the Mack Ave. stamping plant of the company.

BUHR MACHINE TOOL CO., Ann Arbor, Mich., announces the appointment of MICHAEL ZAJAC to the position of vice-president in charge

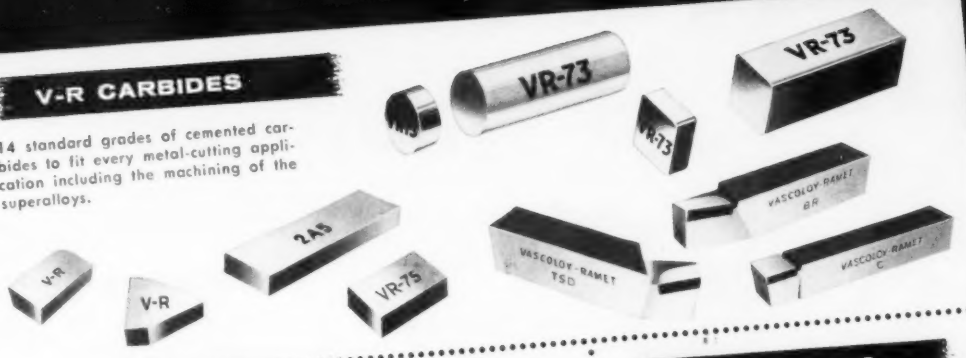
N. M. Forsythe, president, National Automatic Tool Co.

Michael Zajac, vice-president-engineering, Buhr Machine Tool Co.

# VASCOLOY-RAMET Manufactures the Most Complete Line of Cutting Tools for the Machine Tool Industry

## V-R CARBIDES

14 standard grades of cemented carbides to fit every metal-cutting application including the machining of the superalloys.

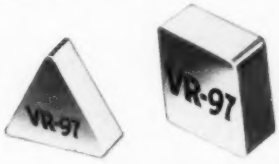



## V-R TANTUNG

Cast alloy cutting tool material for applications requiring cutting speeds between the maximum possible with high speed steel and the minimum practical with cemented carbides.

## V-R CERAMIC

Aluminum oxide cutting tool material for ultra high-speed machining.

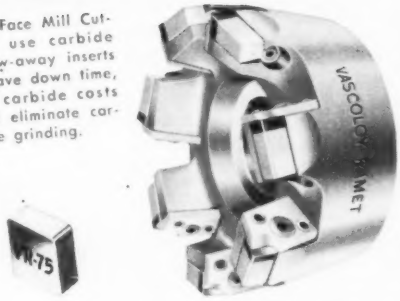



## V-R TOOLHOLDERS and INSERTS

Both Elevator Type and Solid Base Type are available in styles for all applications. Full length and throw-away carbide and ceramic inserts.

## V-R FACE MILL CUTTERS

V-R Face Mill Cutters use carbide throw-away inserts —save down time, cut carbide costs and eliminate carbide grinding.



25 YEAR WARRANTY

For full information on the Complete V-R Line call your local V-R Representative or Distributor or write for the big new 88-page catalog No. VR-58.

MANUFACTURERS OF:
CEMENTED CARBIDES, TOOLHOLDERS, AND TANTUNG® CAST ALLOY CUTTING TOOLS

# Vascoloy-Ramet Corporation

SUBSIDIARY OF FANSTEEL METALLURGICAL CORPORATION

870 Market Street • Waukegan, Illinois

C-668

For more information fill in page number on Inquiry Card, on page 197

of engineering. JAMES E. BARNES has been appointed sales engineer for indirect field sales.

Grant A. Morrison, manager of product design and application engineering, Metallurgical Products Department, General Electric Co.

METALLURGICAL PRODUCTS DEPARTMENT of GENERAL ELECTRIC CO., Detroit, Mich., has named GRANT A. MORRISON manager of product design and application engineering. THOMAS L. MCSWINE has been appointed sales representative in the Atlantic district.

WESSON CO., Detroit, Mich., announces the appointment of EUGENE PLOUCHA as field sales engineer for northwestern Ohio and southeastern Michigan. He will continue to make his headquarters at 740 Alexandrine, Mount Morris, Mich. The company also wishes to announce that the W. H. LUTZ CO., with headquarters in Wheaton, Ill., has recently been appointed its representative in McHenry, DeKalb, Kane, DuPage, LaSalle, Grundy, Will, Kendall, and Kankakee counties. Offices are at 130 W. Liberty Drive, Suite 207, Wheaton, Ill.

VICKERS INCORPORATED, Detroit, Mich., has announced the following personnel changes: AL TRAIL, who headed the Rochester, N. Y., office for two years, has been promoted to district sales manager of the Cleveland office. He replaces ARTHUR VAN WORMER, who is being transferred to head the Detroit sales office. DONALD RHODES has been appointed district sales manager at Rochester, N. Y.

HENRY WOHLERS has been appointed staff engineer for the Machine and Tools Division of Michigan Tool Co., Detroit, Mich. Mr. Wohlers will head the field engineering service of the firm.

CHALLENGE MACHINERY CO., Grand Haven, Mich., announces the election of the following officers: J. WESLEY LEE was elected president and general manager, and ROBERT C. GOULD was elected vice-president.

JOSEPH L. PULLIAM has been appointed sales manager of Micromatic Hone Corporation, Detroit, Mich. He served the Micromatic organization in many capacities before reaching his present position.

JOHN W. DELIND has been elected to the board of directors of Sahlin Engineering Co., Inc., Birmingham, Mich.

ROBERT R. DICKEY has been appointed sales manager of Ross Operating Valve Co., Detroit, Mich.

## New England

ROBERT J. CURLEY has been appointed field representative of the Atrax Co., Newington, Conn. He will be responsible for sales and liaison for Atrax in Washington, Oregon, Arizona, the Los Angeles area, and the entire West Coast.

PRATT & WHITNEY CO., Inc., West Hartford, Conn., announced that ALBERT L. KNAPP, vice-president and manager of the company's machinery division, and EDWARD J. SHAGES, vice-president and manager of its cutting tool and gage divisions, have been named to head the sales activities of their respective operations.

NORTON CO., Worcester, Mass., announces the following personnel changes: CARL H. FOLTZ, JR. and THOMAS M. HANKIN have been appointed field engineers. Mr. Foltz has been assigned to the Chicago office and Mr. Hankin is now at the Atlanta office. ROBERT W. BENNETT has been appointed a field engineer at the St. Louis Office.

PRODUCTO MACHINE CO. has announced the opening of a new Producto assembly plant in Boston, Mass., to provide fast service on die sets, diemakers' accessories, and toolroom equipment for industrial plants in Greater Boston and eastern Massachusetts.

## New York and New Jersey

HERBERT C. CRESS has been appointed vice-president and works manager of the Ford Instrument Co., division of Sperry Rand Corporation, Long Island City, N. Y. Mr. Cress has served Sperry Rand in operations and personnel, as well as in other capacities.

ADMIRAL JOSEPH JAMES CLARK, U. S. Navy (retired) has been appointed assistant to the president of Van Norman Industries, Inc., New York City. Admiral Clark will coordinate scientific research and development among the company's eight manufacturing divisions.

WILLIAM L. FISHER has been appointed to the position of Eastern district sales manager for Aronson Machine Co., Arcade, N. Y., with offices in the Philadelphia area.

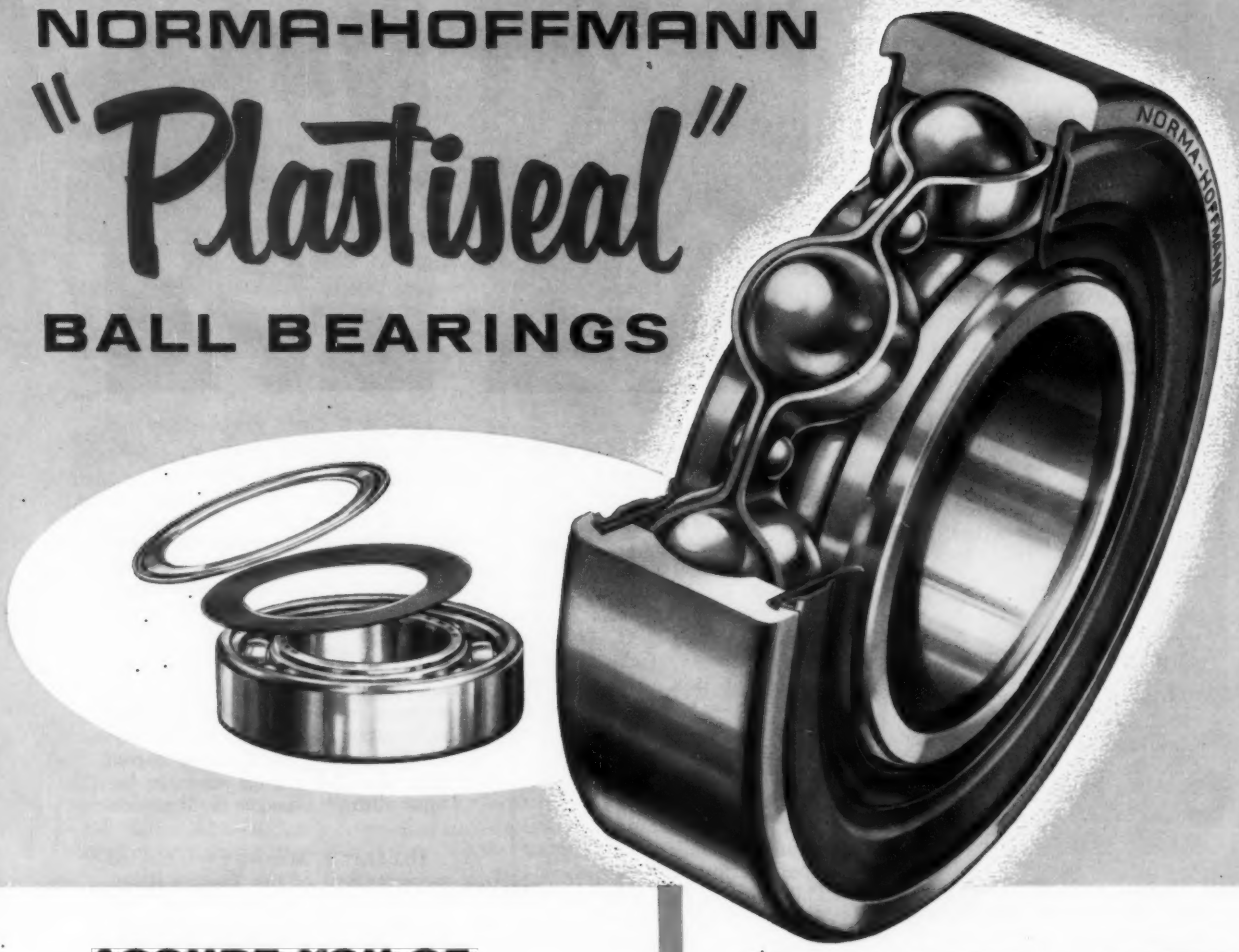
S. D. FLINN has been named assistant to the president of the Supply

(Left) Edward J. Shages, vice-president and manager, cutting tool and gage divisions and (right) Albert L. Knapp, vice-president and manager, machinery division, Pratt & Whitney Co., Inc.

# NORMA-HOFFMANN

# "Plastiseal"

## BALL BEARINGS




## ASSURE YOU OF

## *Maximum Sealing with Minimum Friction*

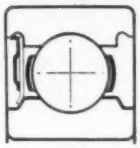
Norma-Hoffmann "*Plastiseal*" Ball Bearings keep out damaging dirt and retain full lubrication. That's because they're made with oil and grease resistant synthetic rubber seals, firmly attached to the outer ring, with very light rubbing contact on the inner ring's smooth recess.

**Other Norma-Hoffmann "Plastiseal" advantages include:**

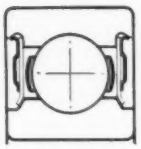
- Low seal friction insuring low wattage and freedom from wear.
- Compact design for completely sealed bearings.
- Prepacking with metered quantity of wide temperature range grease.

For complete details on Norma-Hoffmann's "*Plastiseal*" Ball Bearings, write now for catalog.

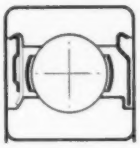
FIELD OFFICES: Philadelphia • Chicago • Cincinnati • Cleveland • Dallas Denver • Detroit • Kansas City • Los Angeles • San Francisco • Seattle



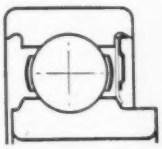
**"K" Series**
with Single Rubber Seal



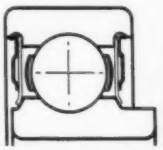
**"KK" Series**
with Double Rubber Seal



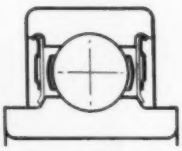
**"KP" Series**
with Single Rubber Seal and Metal Shield



**"8000-K" Series**
with Single Seal and Extended Inner Ring



**"8000-KK" Series**
with Double Seal and Extended Inner Ring



**"88000-KK" Series**
with Double Seal and wide Inner Ring

*precision ball, roller & thrust bearings*

NORMA-HOFFMANN
BEARINGS CORPORATION • STAMFORD, CONN.
*founded 1911*

Division, United States Steel Corporation, New York City. Mr. Flinn has been controller of this division since 1951.

ELECTRO-AUTOSIZING MACHINE CORPORATION has announced its new building and facilities in Closter, N. J., now more adequately equipped to serve the metalworking industry. Its former connection as a Division of Industrial Gauges Corporation was severed as of January 31, 1958. It is now organized as an independent corporation at its new address, 7 William St., Closter, N. J.

JESSEN & GUNDRY, Portland, Oregon, have been appointed exclusive sales representatives in Oregon, Washington, Idaho, and Montana, for the complete line of steel and wire products imported by Kurt Orban Company, Inc., Jersey City, N. J.

## Ohio

JOHN G. FRISCHKORN, JR., has been appointed sales manager of the Cleveland Tramrail Division of The Cleveland Crane & Engineering Co., Wickliffe, Ohio. He succeeds A. F. ANJESKEY, who has retired after 38 years of service with the company.

STANLEY E. HUFFMAN, JR., has been appointed to the new position of manager of sales for the E. W. Bliss Co., Press Division, Toledo, Ohio. Mr. Huffman will be responsible for the administration of all selling policies of the Press Division, including the direction of the field sales organization.

Stanley E. Huffman, Jr., manager of sales, E. W. Bliss Co., Press Division

E. L. Oehling, vice-president, sales, Hydraulic Press Mfg. Co., a division of Koehring Co.

HYDRAULIC PRESS MFG. CO., A Division of Koehring Co., Mount Gilead, Ohio, announced three promotions: E. L. OEHLING was promoted from general sales manager to vice-president-sales; T. G. BISHOP, formerly manager of the plastics machinery division, to product market manager; W. G. KRINER, manager of dealer sales, replaces Mr. Bishop as head of the plastics division.

SCHAUER MANUFACTURING CORPORATION, Cincinnati, Ohio, has appointed the TOWLE INDUSTRIAL CORPORATION, 402 Bethlehem Pike, Philadelphia, Pa., sales representative for Schauer Speed Lathes in the territory of Eastern Pennsylvania, Southern New Jersey, Maryland, and Delaware. JOSEPH C. TOWLE is president and D. H. BELL, vice-president of the Towle organization.

PRECISION WELDER & FLEXOPRESS CORPORATION, Cincinnati, Ohio, announced the appointment of three new representatives. In Chicago, HECK & CO., INC., 5717 North Elston Ave., will handle the complete line of Precision resistance welders. In Chicago and Wisconsin, ZIMMERMAN AND GAMMOND, INC., Pickwick Bldg., 3 S. Prospect, Park Ridge, Ill., will represent the Precision Flexopress line of high-speed stamping presses. In the Philadelphia area, HOWARD GORDON, 429 Chetwynd, Lancaster Pike, Rosemont, Pa., will handle both the welder and press lines for Precision.

JAMES A. D. GEIER was elected vice-president of the Cincinnati Lathe & Tool Co., Cincinnati, Ohio, and appointed assistant general manager of the company. Mr. Geier has been associated with Cincinnati Lathe & Tool Co. and the Cincinnati Milling Machine Co. since April, 1951.

James A. D. Geier, vice-president and assistant general manager, Cincinnati Lathe & Tool Co.

LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, has announced the opening of two new district offices in Memphis, Tennessee, and Albany, N. Y. ROBERT W. THOMAS moved from the Philadelphia office to become district manager in Memphis.

HERBERT E. MARKLEY was elected vice-president of the Timken Roller Bearing Co., Canton, Ohio. Mr. Markley was assistant to the president. RICHARD L. FREDERICK succeeds Mr. Markley in the latter post.

NATIONAL ACME CO., Cleveland, Ohio, announces the promotion of J. L. MOLNER to chief engineer, H. C.

J. L. Molner, chief engineer, National Acme Co.

## Talking About Die Sets

*with*

**Phil Marsilius**

*Executive Vice-President*
*The Producto Machine Co.*

**How to Select and Order a Catalog Die Set**—Do you always order the die set you *really* need for the job...or do you overlook a specification which results in your having to "make do" with the set you ordered or lose time by having to re-order?

Once again, we feel that a simple and basic practice should be emphasized because our daily experiences show that even the most painstaking individual occasionally overlooks one or more factors in preparing to place an order.

**Here is our suggested check-list** for selecting and ordering a catalog die set:

**1. Lay out the die.** Allow sufficient area for feeding devices and auxiliary stock guides that may be required. Determine also what areas must be left clear for part ejection or scrap.

**2. Determine type of set** you need—rear two-pin, four-pin, center-pin, etc.—according to tolerances and construction of die.

**3. Place layout on templates** for the type of die set you have chosen. Select die area that best meets the limits established in Step 1.

**4. Select material** for die set—semi-steel, all-steel or combination—based on the die's strength requirements.

**5. Select thicknesses** of punch and die holder in line with strength requirements and allowable press shut height.

**6. Determine length of guide-pin required*,** based on length of stroke or ram clearance.

**7. Determine type and length of bushing** and material from which it should be made, based on accuracy, speed of operation and required life expectancy of die.

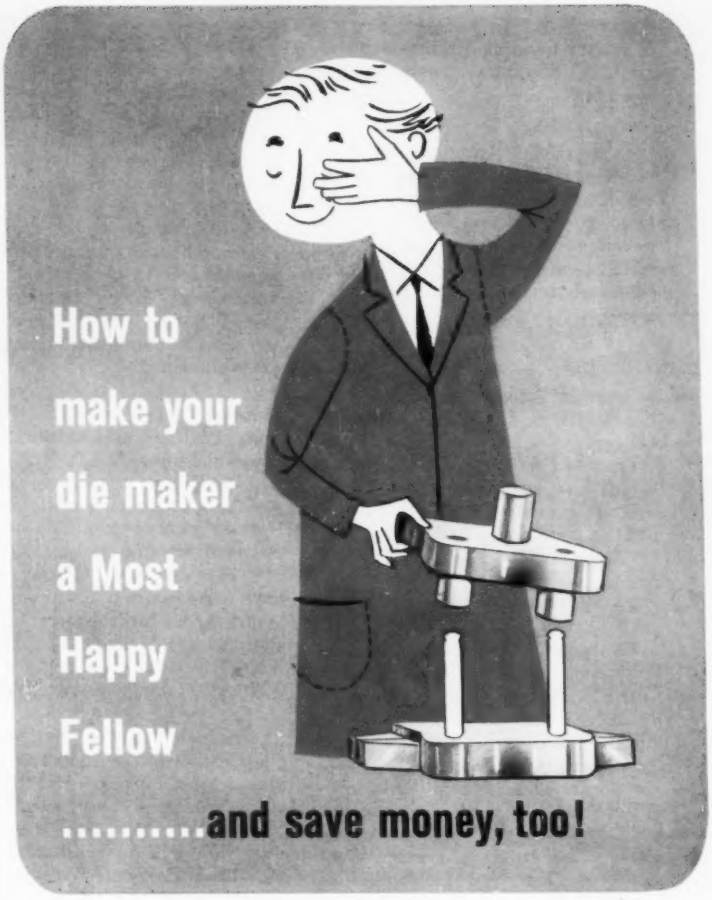
**8. Select shank diameter** for the press on which die will be run.

**9. Choose grade of precision** required—Master or Commercial—based on tolerances and number of pieces to be produced.

**10. Order die set** which meets most closely the above requirements, making certain that *all* ordering information is included: Catalog number and quantity; Master (Precision) or Commercial grade; length of guide pin; type of bushing; diameter of shank or "no shank"; how to ship. Keep in mind that special thicknesses of punch holder and die holder can also be ordered if required.

Of course, you may not find it possible to check these points in the exact sequence presented. However, if you will make it a habit to use this check-list for each die set you need, you can avoid making costly errors in ordering.

*"L" dimensions pertaining to pin length as shown in die set catalogs refer to distance from bottom of die holder to top of pins. They do not necessarily apply to actual guide pin lengths.

It's easy. Just be sure to specify Producto die sets with *Qwik-Fit guide pins.*

Then your die maker will always be able to assemble and disassemble his die sets practically blindfolded! No longer will he have to line up pins and bushings cautiously...tediously hammer die sets together...or pry them apart. With Qwik-Fit guide pins, the die set almost *puts itself together.* The spherical-angular radius on these pins prevents jamming or cocking *regardless of how the punch holder is started on.*

Think of the time your die maker will save...and the money *you* will save. Dies are growing more complex daily and that means assembly and disassembly of the die set dozens of times. In plants all over the country, Producto's Qwik-Fit pins are saving up to 75% of the time formerly required for these operations.

To improve morale and increase productivity, join the growing ranks of die manufacturers and users who specify "Producto die sets with Qwik-Fit guide pins." They are available on Master die sets at no extra cost.

**HOW TO MAKE ORDERING EASIER:**

Get your free copy of Producto's Die Set Catalog No. 11, designed specifically to simplify your selection and ordering job. And ask to receive the idea-filled Die Set Digest, too.

THE PRODUCTO MACHINE COMPANY

985 Housatonic Avenue, Bridgeport 1, Connecticut

Wherever die sets are used

PRODUCTO

PRODUCE MORE WITH PRODUCTO PRECISION DIE SETS

For more information fill in page number on Inquiry Card, on page 197

MATLOCK to administrative engineer, and B. C. BUTLER to general superintendent.

STANLEY L. NITKIEWICZ has been promoted to chief engineer of Abbey-Etna Machine Co., Perrysburg, Ohio. He will be responsible for the development of new equipment, its installation, service, and engineering-customer relations throughout the world.

J. L. CHASE has been appointed Detroit district sales manager for the E. W. Bliss Co., Press Division, Canton, Ohio. He succeeds F. P. O'KEEFFE, who has retired. Mr. Chase has served in various engineering, administrative, and sales capacities for the company.

## Pennsylvania

CARPENTER STEEL CO., Reading, Pa., announced that it has established Bridgeport, Conn., as a producing and shipping point for all its grades of stainless steels shipped to the major part of New England and the metropolitan New York City area. The firm is now producing stainless steels in Bridgeport at its recently acquired subsidiary, Carpenter Steel of New England, Inc.

CRUCIBLE STEEL COMPANY of AMERICA, Pittsburgh, Pa., announces the following personnel changes: the election of L. L. FERRALL as executive vice-president, and J. D. DICKERSON as vice-president-operations. Mr. Ferrall was formerly vice-president-operations and Mr. Dickerson was manager of steel production.

L. L. Ferrall, executive vice-president, Crucible Steel Company of America

DONALD S. FOOTE was appointed to the position of works manager-Titanium Division at Midland, Pa.; HOWARD T. CLARK, JR., was named manager, Midland, Pa., research laboratory, a part of the company's newly created technology department.

A. D. NUSSER has been appointed assistant manager of the Pittsburgh sales branch; D. G. WATSON was appointed tool steel supervisor, and W. C. BAUM, stainless steel supervisor at Crucible's Indianapolis, Ind., sales branch.

LANDIS MACHINE CO., Waynesboro, Pa., has announced the purchase of MAIDEN & CO. LTD., Cheshire, England, a more than 100-year old manufacturer of bolt and pipe threading equipment. The new concern will be known as Landis Machine-Maiden Ltd. Officials of the new company are: chairman of the board—J. M. MCNEAL, export manager, Landis Machine Co., Waynesboro, Pa.; and managing director—G. Barry Tinker, Prestvery, England.

ARTHUR C. CONNOR has been appointed sales representative in the Philadelphia area for Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y. Mr. Connor will represent R B & W in Washington, D.C., Maryland, Delaware, eastern Pennsylvania, and the Camden-Trenton area of New Jersey. His headquarters will be in the company's Ardmore, Pa., office.

WILLIAM C. STONEHOUSE, JR., a management consultant and employe-relations expert, has been appointed director of industrial relations for Latrobe Steel Co., Latrobe, Pa. Mr. Stonehouse will supervise all industrial relations functions for Latrobe Steel, including negotiations with the company's employes.

JACQUES W. LOURIE has been named director of foreign sales for Baldwin - Lima - Hamilton Corporation, Philadelphia, Pa. Mr. Lourie will coordinate all foreign sales activities for heavy industrial products of the corporation's six industrial divisions.

JOHN J. COATES has been appointed plant manager of the Esso Standard Oil Company's grease plant located in Pittsburgh, Pa.

LANDIS TOOL CO., Waynesboro, Pa., has appointed the WM. C. JOHNSON & SONS MACHINERY CO., 1211 Hadley St., St. Louis 6, Mo., exclusive distributor for Landis grinders in the eastern Missouri and southern Illinois territory.

## Wisconsin

WARNER ELECTRIC BRAKE & CLUTCH CO., Beloit, Wis., announces the appointment of two new power-transmission distributors to cover western Michigan and New Jersey. MACKAY INDUSTRIAL SALES COMPANY of Grand Rapids, Mich., will cover the eighteen counties in western Michigan. Mackay's office and warehouse is located at 2131 Kalamazoo Ave., S.E.

SQUIRE, SCHILLING & SKIFF, division of the Alban Corporation, will cover a ten-county territory in central and north-central New Jersey from its headquarters at 415 Plane St., Newark, N. J.

GIDDINGS & LEWIS MACHINE TOOL CO., Fond du Lac, Wis., has purchased the land, building, and foundry equipment of the PRESCOTT CO., Menominee, Mich. The Prescott Co. will continue its manufacture of sawmill machinery and diesel engines, as well as contract work in the machine shop. The plant area to be used in these operations will be leased from Giddings & Lewis.

* * *

## Machine Tool Show and Demonstration

The Motch & Merryweather Machinery Co., Cleveland, Ohio, held a Machine Tool Show and Demonstration June 3 to 7 at its new plant in that city. Many new models of metalworking machines were shown. Operations such as milling, grinding, boring, drilling, and tapping were demonstrated on a variety of equipment from some of the foremost manufacturers in the field.

* * *

## American Welding Society Elects Officers

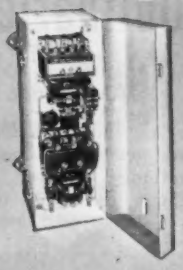
Gustav O. Hoglund, Pittsburgh, Pa., was elected president of the American Welding Society at the opening session of its recent annual meeting. Mr. Hoglund is head of the welding section of the Process Development Laboratory, Aluminum Company of America. Other officers elected included Charles I. MacGuffie, manager of marketing of the welding department of the General Electric Co., first vice-president; and R. David Thomas, Jr., president of Arcos Co., second vice-president.

# ALLEN-BRADLEY *Quality* Reduced Voltage Motor Starters

### AUTOMATIC GRAPHITE RESISTOR TYPE

Graphite disc resistors are automatically inserted in series with the squirrel cage motor at starting. These resistors can be steplessly adjusted for motor and load conditions, resulting in remarkably smooth acceleration of the motor.

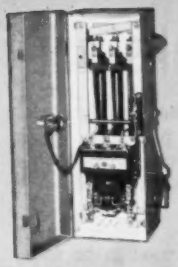
**BULLETIN 740**



### MANUAL STEPLESS RESISTANCE TYPE

Graphite compression disc resistors provide smooth, stepless starting of polyphase squirrel cage motors—prevent lamp flicker. Operated by a hand lever, the smooth starting of the motor is under the control of the operator.

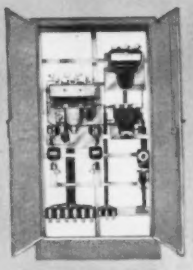
**BULLETIN 640**



### AUTOMATIC MULTIPOINT RESISTANCE TYPE

Meets power company starting current rules on network systems. Resistors are automatically inserted in the line at starting, and are short circuited in steps at definite time intervals which can be adjusted from 1 to 5 seconds.

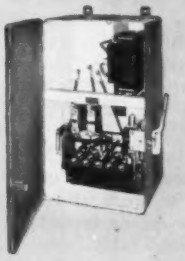
**BULLETIN 741**



### MANUAL AUTOTRANSFORMER TYPE

Recommended where the characteristics of the driven load or power company rules require reduced voltage starting. Double break, silver alloy contacts are standard for air-break starters . . . copper contacts for oil-immersed units.

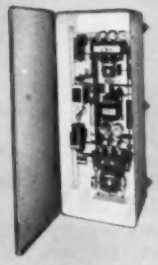
**BULLETIN 646**



### AUTOMATIC STEPLESS GRAPHITE RESISTOR TYPE

The ultimate in velvet smooth acceleration of squirrel cage motors. Lamp flicker on network systems used for both power and light is eliminated. The graphite disc resistors are compressed automatically . . . smoothly and steplessly.

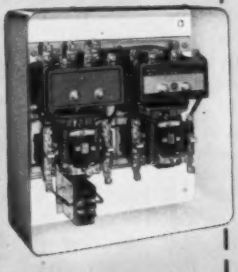
**BULLETIN 742**



### AUTOMATIC PART-WINDING TYPE

For use with squirrel cage motors having two separate parallel stator windings. Two types—Style A, two step starter; Style B, three step starter having resistance in series with motor on the first step.

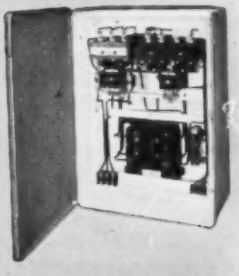
**BULLETIN 736**



### AUTOMATIC AUTOTRANSFORMER TYPE

Utilizes an autotransformer connected in open delta to reduce line voltage for starting squirrel cage motors. Taps are provided on the autotransformer to adjust the voltage applied to the motor.

**BULLETIN 746**



A-B QUALITY

The Sign of QUALITY Motor Control

## ALLEN-BRADLEY MOTOR CONTROL QUALITY

Allen-Bradley Co., 1315 S. First St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

# Obituaries

### Alexander S. Keller

Alexander S. Keller, vice-president and general sales manager of Pratt & Whitney Co., Inc., West Hartford, Conn., died May 16 at the age of

Alexander S. Keller

fifty-three. Mr. Keller was widely known as an expert in machine tool design, and at one time, was a senior advisor in the Netherlands under the Economic Cooperation Administration. Mr. Keller came from a family prominent in the machine tool industry. His father founded the Keller Mechanical Engineering Corporation, which built the widely known Keller tracer-controlled machines. Mr. Keller came to Pratt & Whitney with the merger of his father's firm, being appointed manager of the Keller Sales Division and holding that post from 1935 to 1944. He was named a vice-president of Niles-Bement-Pond Co. in 1944. Mr. Keller remained with the firm until 1949, when he became president of the Lamb Electric Co., Kent, Ohio. Shortly thereafter he was named to the ECA mission in the Netherlands. Upon his return to the United States, Mr. Keller became vice-president of the Lamb Electric Co., and in 1955 returned to Pratt & Whitney as vice-president and general sales manager. In addition to his business interests, Mr. Keller was active in civic and philanthropic affairs.

JAMES D. GLENN, aged 52, former vice-president and general manager of sales for Crucible Steel Company of America, died May 8. Active in the steel sales field since 1955, Mr. Glenn was widely known throughout the industry. He joined Crucible in 1948 in Pittsburgh as general manager of stainless-steel sales and was named general manager of sales in 1954. The next year he was elected vice-president and general manager of sales for the company. He retired from active service last year because of ill health.

FRED C. DULL, aged 63, vice-president and treasurer of The Monarch Machine Tool Co., Sidney, Ohio, died June 1. Mr. Dull joined Monarch in 1918 as an accountant. He observed his fortieth anniversary with the company in April of this year.

WILLIAM HUNT EISENMAN, aged 73, secretary and a founder-member of the American Society for Metals, died May 30. Mr. Eisenman, who served the American Society for Metals for 40 years and was managing director of the National Metal Exposition and Congress ("Metal Show"), succumbed following a heart attack at his Palm Springs, Calif., vacation home.

# New Books and Publications

STRENGTH OF MATERIALS. By F. R. Shanley. 783 pages; 6 by 9 inches. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price, $8.50.

This book is designed to be used as a first text in college courses in engineering and science. Because of this, the order of presentation is given careful attention. The text does not exercise any particular field of structures but instead contains material which forms the basis for all types of structural analysis and design. Examples and problems include practical cases from fields of civil, aeronautical, and mechanical engineering. The scope of the book has been expanded considerably beyond the usual limitations for a text of this type. Recent developments, many developed through the author's own investigations and not previously published, include: inelastic column theory, engineering treatment of buckling of thin plates and shells, and applications of moment-distribution method or solution of statically-indeterminate structures.

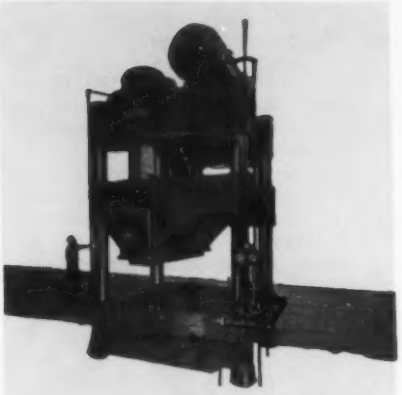
HANDBOOK OF LAYOUT AND DIMENSIONING FOR PRODUCTION. By Hyman H. Katz. 479 pages, 6 1/2 by 9 1/2 inches. Published by the Macmillan Co., 60 Fifth Ave., New York 11, N. Y. Price, $15.

This book provides the know-how not offered by the conventional academic approach to engineering drawing. It stresses practical industry-defined layout, and demensioning requirements. Each step in product development, from technical sketch to final drawing, is illustrated and detailed in terms of the procedures, principles, and theory involved. Each step is related to the ultimate goal—optimally efficient mass production. Writing clearly, organizing his material systematically, and referring constantly to the most exacting industrial standards, the author offers a book which is as valuable a reference for the skilled draftsman and designer as it is a basic text for the beginner.

MATHEMATICS FOR SCIENCE AND ENGINEERING. By Phillip L. Alger. 355 pages, 6 by 9 inches. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. Price, $5.50.

This text constitutes the author's complete revision of ENGINEERING MATHEMATICS by Charles P. Steinmetz. The purpose of the book is to help students or engineers to use mathematics effectively. Every method and formula given is so clearly explained that there is no need for memorizing and no likelihood of misapplication of formulas. Arithmetic, trigonometry, algebra, calculus, probability, etc., are considered in successive chapters, so each subject is derived as a natural extension of the earlier chapters. The text contains about 80 per cent of the mathematical procedures and methods which an engineer or technician will need to use in the course of his career.

FACE-TO-FACE AND END-TO-END DIMENSIONS OF FERROUS VALVES. ASA B16.10-1957. 23 pages, 8 by 11 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y. Price, $1.50.



1500-ton Heavy-Duty Forming Press for bending and forming operations on heavy steel plate. Moving platen can be tilted right or left during stroke. Furnished complete with prefill system, operating valves, piping and pressure gauges. Can be furnished in a complete range of sizes for bending and forming plates of all thicknesses. For details of this or other presses for the metalworking industry, write us today.

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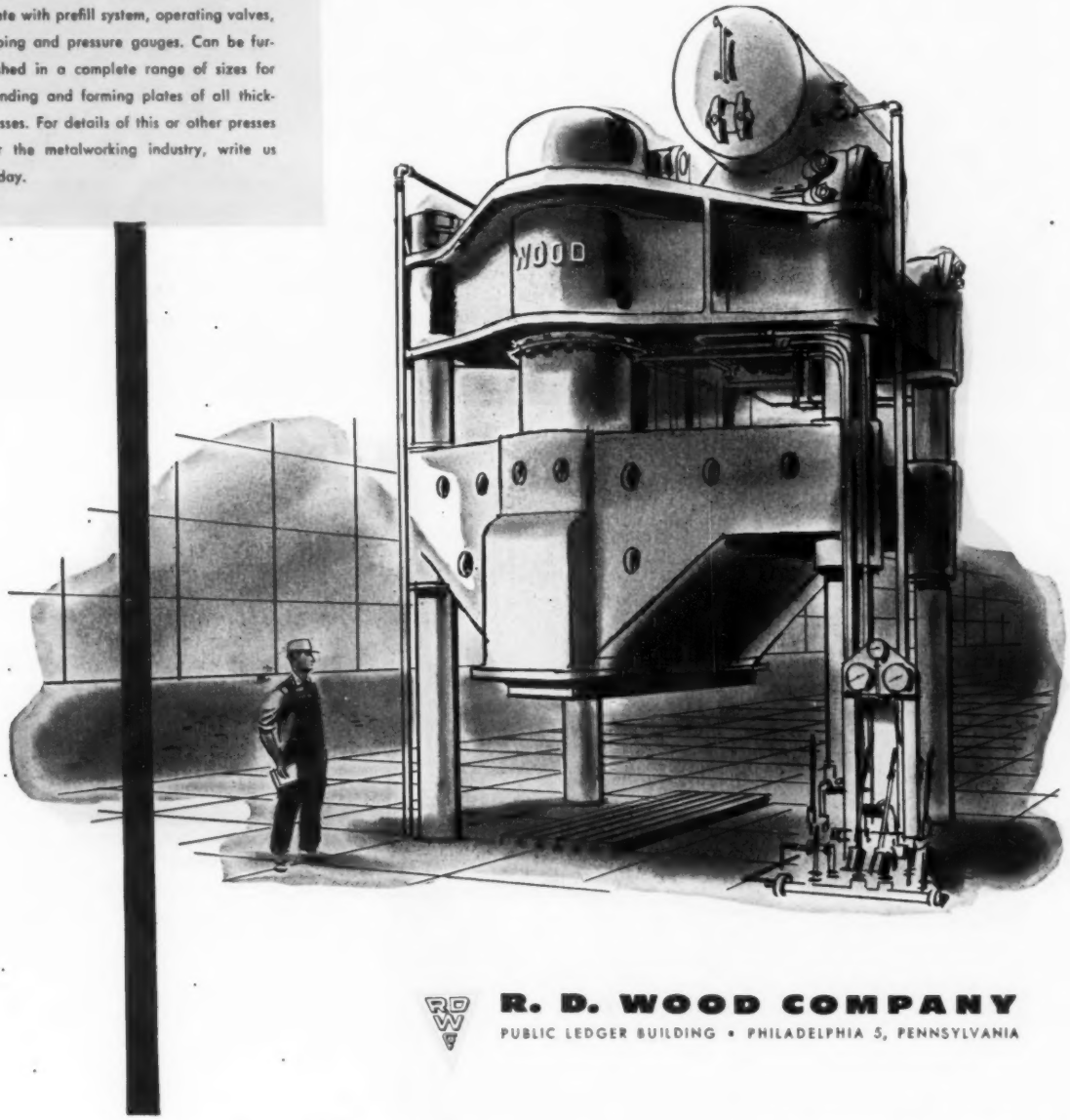
It's just plain common sense—when your down-time decreases your production is bound to increase. Down-time can't be eliminated, but R. D. Wood Presses hold it to a minimum. The sound design, choice materials and careful craftsmanship that go into a Wood Press produce a superior product—a dependable, smooth-working press that can't help but increase production records. Write for our catalog and engineering information—no obligation.

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# Coming Events

SEPTEMBER 23-26—Association of Iron and Steel Engineers' 1958 Iron and Steel Exposition and Convention will be held in Public Auditorium, Cleveland, Ohio. The Association's address is 1010 Empire Building, Pittsburgh 22, Pa. The managing director: T. J. Ess; exposition manager: William C. Friesel.

SEPTEMBER 29-OCTOBER 3—American Society of Tool Engineers' Semi-Annual Meeting and Western Tool Show will be held at Shrine Exposition Hall, Los Angeles, Calif. Exposition committee: Leonard Abrams, ASTE, 10700 Puritan Ave., Detroit 38, Mich.; Harry E. Conrad, executive secretary.

OCTOBER 27-31—National Metal Exposition and Congress will be held at the Cleveland Public Auditorium, Cleveland, Ohio. The same week the annual meeting of the AMERICAN SOCIETY FOR METALS, the SOCIETY FOR NONDESTRUCTIVE TESTING, and the AMERICAN INSTITUTE OF MINING, METALLURGICAL, AND PETROLEUM ENGINEERS—INSTITUTE OF METALS DIVISION, will be held. For further information contact American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

## Coated-Abrasive Machine Show

The growing importance of coated abrasives as a basic industrial tool was emphasized this June when 150 new abrasive machines were viewed and tested by visitors to the Behr-Manning Co.'s Third National Coated-Abrasive Machinery Show. The week-long show was held in the company's new product-engineering building in Watervliet (Troy), N. Y. Production men from all phases of industry brought actual work-pieces, using them to subject the various new machines to comparative testing of their grinding and polishing performance.

Among advances in machine tool design was a conspicuous "beefing up" of frames, bearings, and drive trains to keep pace with improvements in abrasive belts; and with the increasing forces being exerted in heavy stock removal, descaling, and similar work. More attention was also paid to flooding the work areas with coolants, and to better filtration of the coolant. Exhibits included a 150-hp pinch-roll grinder using a 50-inch wide abrasive belt developed for descaling sheet mechanically (instead of pickling it); a 40-foot longitudinal polisher for tube, bar, and extruded sections; a centerless abrasive-belt grinder with fully automatic gaging; and a rubber-roll grinder able to hold 0.001-inch tolerances on rolls of face widths up to 80 inches. Also demonstrated were a 1000-gallon sub-floor filtration unit with an automatic elevator to deposit wastes in a disposal tank, new dust-collection systems, and a belt storage room held to ideal conditions of temperature and humidity. Behr-Manning is the coated-abrasives manufacturing division of Norton Co., Worcester, Mass.

* * *

## Purdue to Play Host to Joint Sales Conference

The annual conference of sales executives, advertising managers, and sales engineers of member companies of the National Machine Tool Builders' Association and the American Machine Tool Distributors' Association will be held this year at Purdue University, Lafayette, Ind., from July 28 to August 1. The conference is the thirteenth such program since 1948 to be shared by the two groups. Advance indications are that 150 or more men will participate in the five-day program. To date, over 1550 men from 125 machine tool companies and 100 distributor organizations have attended one or more of these conferences.

**Brazed honeycomb panel of stainless steel is being dipped into a tank containing 50 per cent nitric acid solution at the Martin Co., Baltimore, Md. After soaking for approximately twenty hours at room temperature the silver brazing alloy is completely dissolved, leaving the stainless-steel details unharmed. The acid is periodically shipped to Handy & Harman, New York City, where hundreds of ounces of silver are recovered. Also, the panels, now free of brazing alloy, command a higher salvage price.**

*Illustrated—New 9700 Series*
*Piggy Back Hydraulic Control Valve.*

Look to Logan

# the ultimate in hydraulic valve design

**FREE** SEND FOR THE "LOGAN CALCULATOR"
A gift to you from Logansport Machine Company upon request.

MEMBER: Natl. Mach. Tool Builders Assn.; Natl. Fluid Power Assn.

**LOGANSPORT MACHINE CO., INC.**
**810 CENTER AVENUE, LOGANSPORT, INDIANA**

PLEASE SEND COPY OF CATALOG:

- ☐ 100-1 AIR CYLINDERS
- ☐ 100-2 MILL-TYPE AIR CYLS.
- ☐ 100-3 AIR-DRAULIC CYLS.
- ☐ 100-4 AIR VALVES
- ☐ 100-5 LOGANSQUARE CYLINDERS
- ☐ 100-6 ULTRAMATION CYLINDERS
- ☐ 300-2 PRESSES
- ☐ FACTS OF LIFE
- ☐ 200-1 HYD. POWER UNITS
- ☐ 200-2 ROTOCAST HYD. CYLINDERS
- ☐ 200-3 750 SERIES HYD. CYLINDERS
- ☐ 200-4 AND 200-7 HYD. VALVES
- ☐ 200-6 SUPER-MATIC CYLS.
- ☐ 300-1 CHUCKS
- ☐ ABC BOOKLET
- ☐ CIRCUIT RIDER

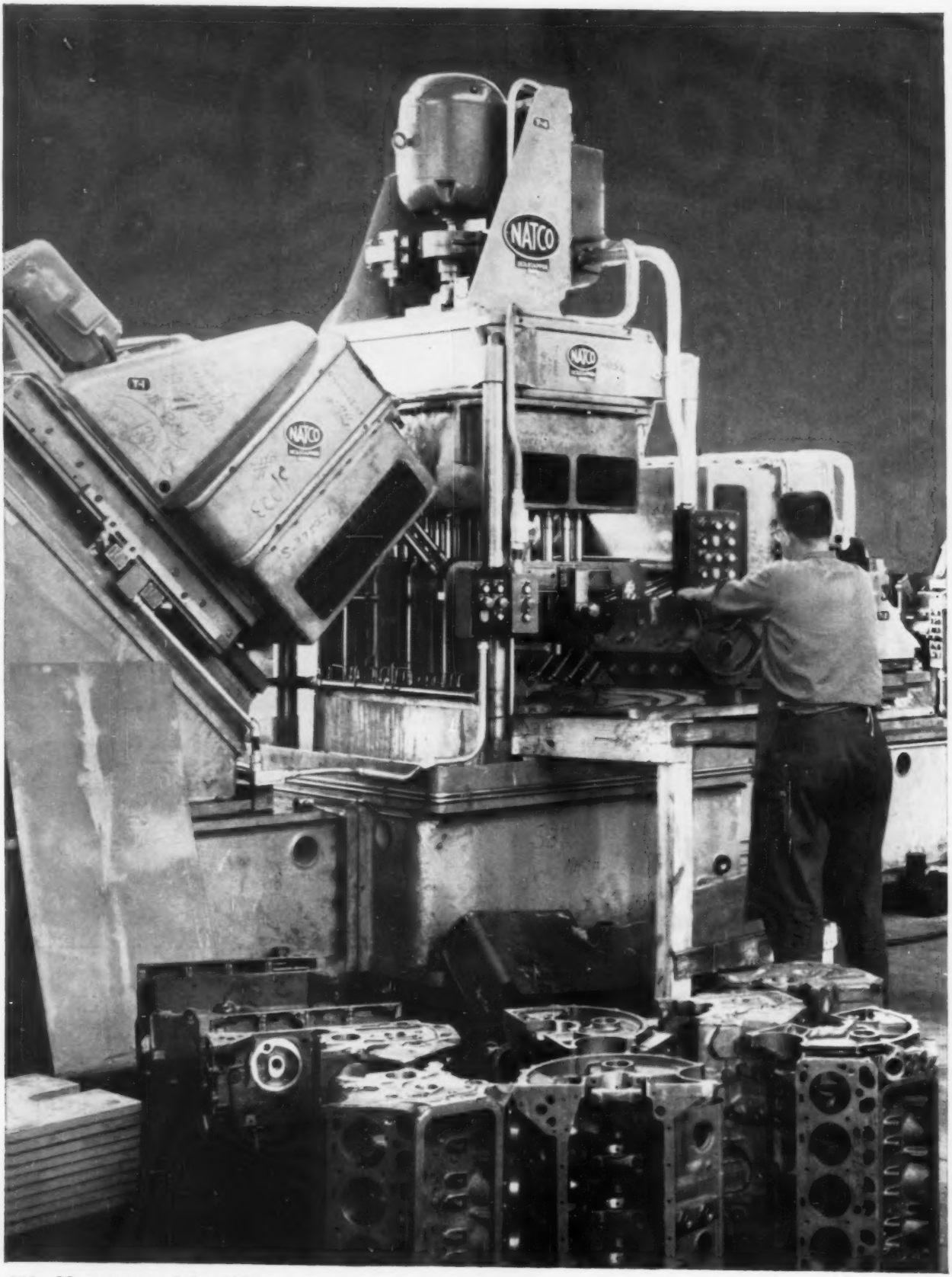
**TO:**

NAME_____ TITLE_____

COMPANY _____

ADDRESS _____

For more information fill in page number on Inquiry Card, on page 197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# Must your transfer machine go to scrap every time your model changes?

Certainly not. For example, the way-type machines shown here were once stations in an automated straight-line transfer machine. Now they will begin their second life as individual machines on a shorter-run lower-production assignment.

Each station in your Natco transfer machine—whether drilling, boring, milling, sawing or chamfering—is a machine tool in its own right. With modifications and new tooling, it may serve you for many years beyond its original "single-purpose" life.

When product changes call for new tooling, consider adapting the previous machinery to a new use—and realize substantial savings. Natco engineers and manufacturing facilities are at your disposal to make the necessary modifications. Call your nearby Natco representative today to discuss converting your equipment.

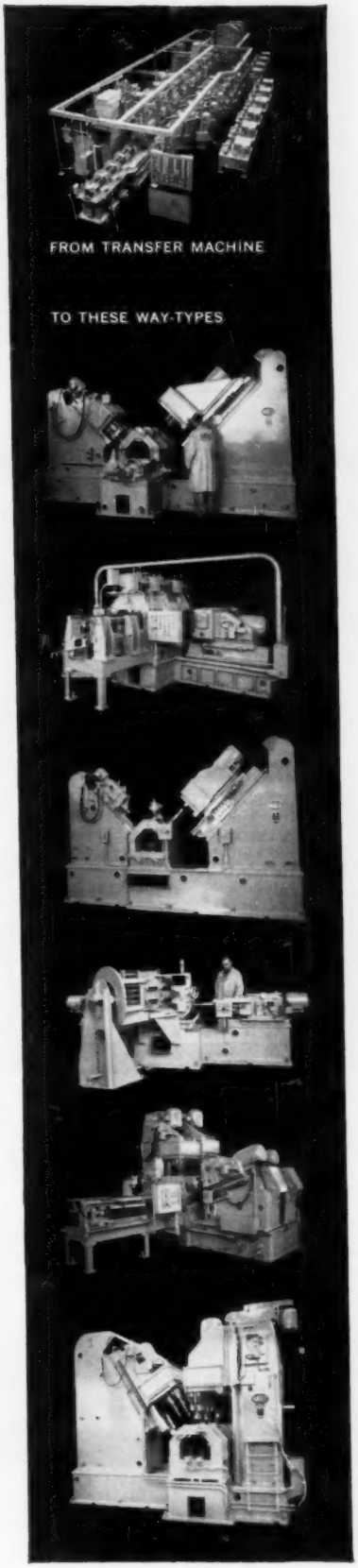
NATCO

*Multiple-spindle drilling, boring, facing and tapping machines. Special machines for automatic production.*

NATIONAL AUTOMATIC TOOL COMPANY, INC.

Dept. 794-D, Richmond, Indiana

Natco offices in Chicago, Detroit, Buffalo, New York, Boston, Philadelphia, Cleveland and Los Angeles. Distributors in other cities.



# Product Directory

**To find headings easily, look for capital letters at top of each page to denote location.**

**ABRASIVE CLOTH, Paper and Belt**
Crane Packing Co., Morton Grove, Ill.
Gardner Machine Co., Beloit, Wis.
Norton Co., 1 New Bond St., Worcester, Mass.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 35, Penna.

**ABRASIVES, Disc**
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.

**ABRASIVES, Polishing, Tumbling, Etc.**
Crane Packing Co., Morton Grove, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 35, Penna.

**CIRCLE R** precision underwrites your precision by holding within very close tolerances, where required. And just as hairline precise in its own way is the skill of Circle R representatives. Call them in as consultants—especially on development of special circular cutting tools to ensure better production with controlled costs.

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METAL SLITTING SAWS
COPPER SLITTING SAWS
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COMMUTATOR SLOTTING SAWS
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638-7

CIRCULAR TOOL CO., INC.
PROVIDENCE 5, RHODE ISLAND
Specialists in Circular Cutting Tools Since 1923


**ACCUMULATORS, Hydraulic**
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

**AIR GAGES, Dimensional**—See Gages Air Comparator

**AIR GUNS**
Chicago Pneumatic Tool Co., New York 17, N. Y.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

**AIR TOOLS**—See Grinders, Portable, Pneumatic—Drills, Portable, Pneumatic, Etc.

**ALLOY STEELS**
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Ryerson Joseph T., & Son, Inc., 2558 W. 16th St., Chicago 18, Ill.
U. S. Steel Corp., Carnegie-Illinois Steel Corp. Div., 436 7th Ave., Pittsburgh, Pa.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

**ALLOYS, Bearing**
Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio.
Mueller Brass Co., Port Huron, Mich.

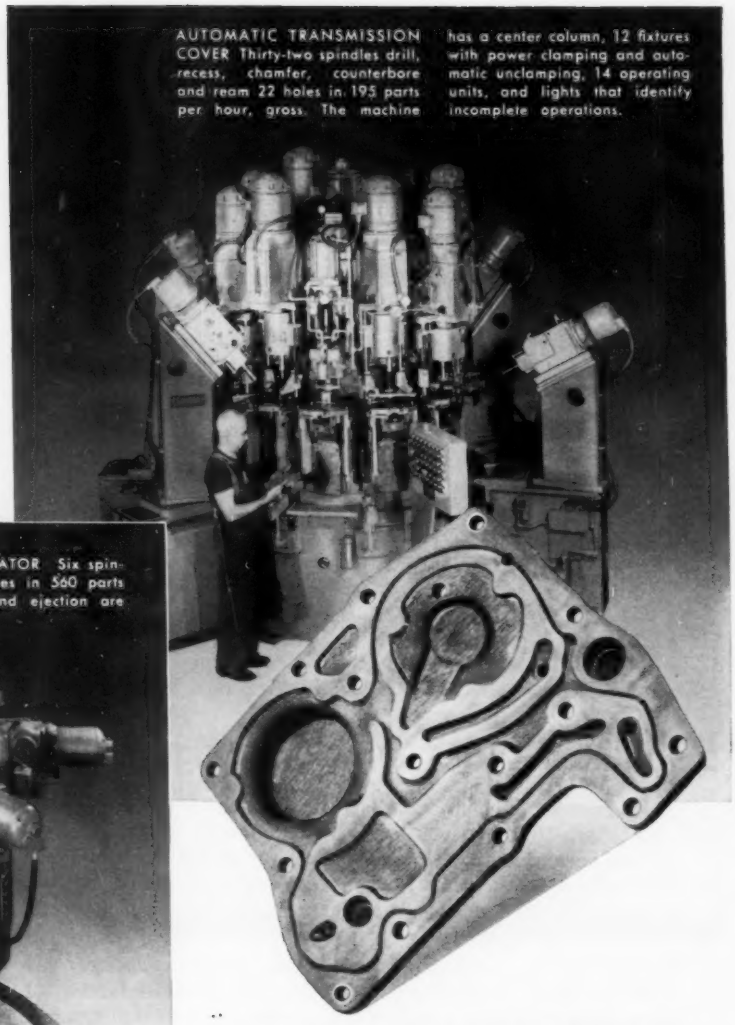
**ALLOYS, Non-ferrous**—See Brass, Copper, Zinc and Stellite

**ALUMINUM and Aluminum Products**
Mueller Brass Co., Port Huron, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Ryerson & Son, Jos. T., 16th & Rockwell Sts., Chicago 8, Ill.

**ANGLE PLATES**—See Set-Up Equipment

**ANNEALING FURNACES**
Eisler Engrg. Co., 750 So. 13th St., Newark 3, N. J.

. . . whether your drilling and tapping jobs are SIMPLE or COMPLEX



AUTOMATIC TRANSMISSION COVER Thirty-two spindles drill, recess, chamfer, counterbore and ream 22 holes in 195 parts per hour, gross. The machine has a center column, 12 fixtures with power clamping and automatic unclamping, 14 operating units, and lights that identify incomplete operations.

COUNTERWEIGHT FOR REFRIGERATOR Six spindles spot, drill and tap two holes in 560 parts per hour, gross. Unclamping and ejection are automatic.

. . . YOU PRODUCE MORE GOOD PARTS, MONTH AFTER MONTH . . . ON A

# KINGSBURY

One job is fairly simple, one complex, but both parts are produced at a high production rate with few rejects and little down time. Good basic design is the main reason. Each job had careful study so that the fixtures would hold the parts firmly and accurately and the tools operate as required.

Before we shipped these machines, we ran sample parts that gaged perfectly. When each customer received his machine it was ready to produce. Rugged construction will keep them producing month after month without trouble.

We've been building successful machines like these for 38 years. Ask us to quote one of your jobs. Kingsbury Machine Tool Corporation, Keene, N.H.

KINGSBURY INDEXING AUTOMATICS for high production drilling and tapping

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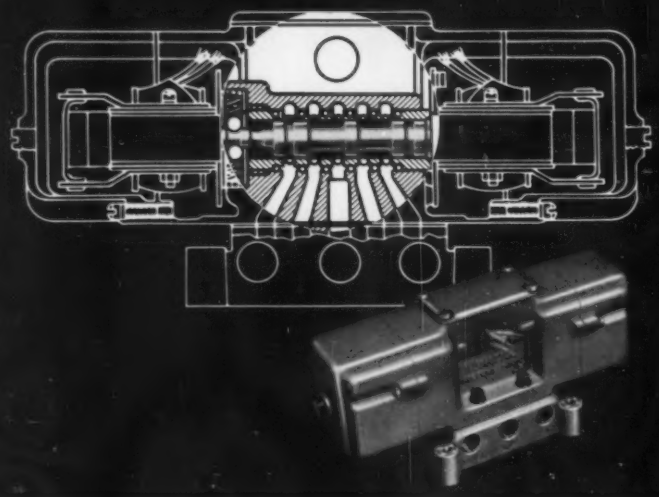
It's the air valve with the floating sleeve-lapped spool design



## 50 million cycles without a sign of wear!

This is not just a claim, it's a fact! And Numatics has the verified case histories to prove it . . . cases where Numatics SA Series valves are still performing like new after well over 50 million operations. *And not on a test bench under ideal conditions,* either, but out in the field on high speed welding guns, punch press scrap choppers, high speed packaging machines and other actual installations.

With the floating sleeve-lapped spool you can expect *and get* this kind of performance from every Numatics valve, because the spool has no seals or packers to wear out . . . it floats on a fluid film, never contacts the sleeve wall. The sleeve floats, too, on O-rings which isolate it from the valve body. Both spool and sleeve, what's more, are specially heat treated stainless steel, close-tolerance finished to minimize friction. In a nutshell, Numatics valves are designed and built to give you longer, more trouble-free life than is possible with ordinary air valves. Want a catalog? Send for it!

**LOOK TO NUMATICS FOR LINE VALVES, TOO . . .**

*Numatics offers a* complete *line of high speed, heavy duty 2-and 3-way in-line valves . . . valves you can depend on for top performance, long life, minimum maintenance and applications unlimited. And we'd like to* prove *it! May our representative call on you?*

**NUMATICS, Inc.** HIGHLAND, MICHIGAN

SALES REPRESENTATIVES FROM COAST TO COAST


**ARBOR PRESSES**—See Presses Arbor

**ARBORS AND MANDRELS**

Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio
Jacobs Mfg. Co., West Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Supreme Products, Inc., 2222 S. Calumet Ave., Chicago 16, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

**ARC WELDERS**—See Welding Equipment, Arc

**ASSEMBLING MACHINES**

Detroit Power Screwdriver Co., 2799 W. Fort St., Detroit 16, Mich.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Robbins, Omer E. Co., 24800 Plymouth Rd., Detroit 39, Mich.
Sheffield Corp., Box 893, Dayton 1, Ohio

**AUTOMATIC SCREW MACHINES**—See Screw Machines, Single and Multiple-Spindle Automatic

**AUTOMATION EQUIPMENT**

Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.

**BABBITT**

Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

**BALANCING EQUIPMENT**

Gisholt Machine Co. (Static and Dynamic), 1245 E. Washington Ave., Madison 10, Wis.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mach. Tool Co., 2531 11th St., Rockford, Ill.

**BALLS**

Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Hoover Ball & Bearing Co., Ann Arbor, Mich.

**BAR MACHINES**—See Screw Machines, Single and Multiple-Spindle, Automatic

**BAR STOCK, Non-ferrous**

Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Mueller Brass Co., Port Huron, Mich.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

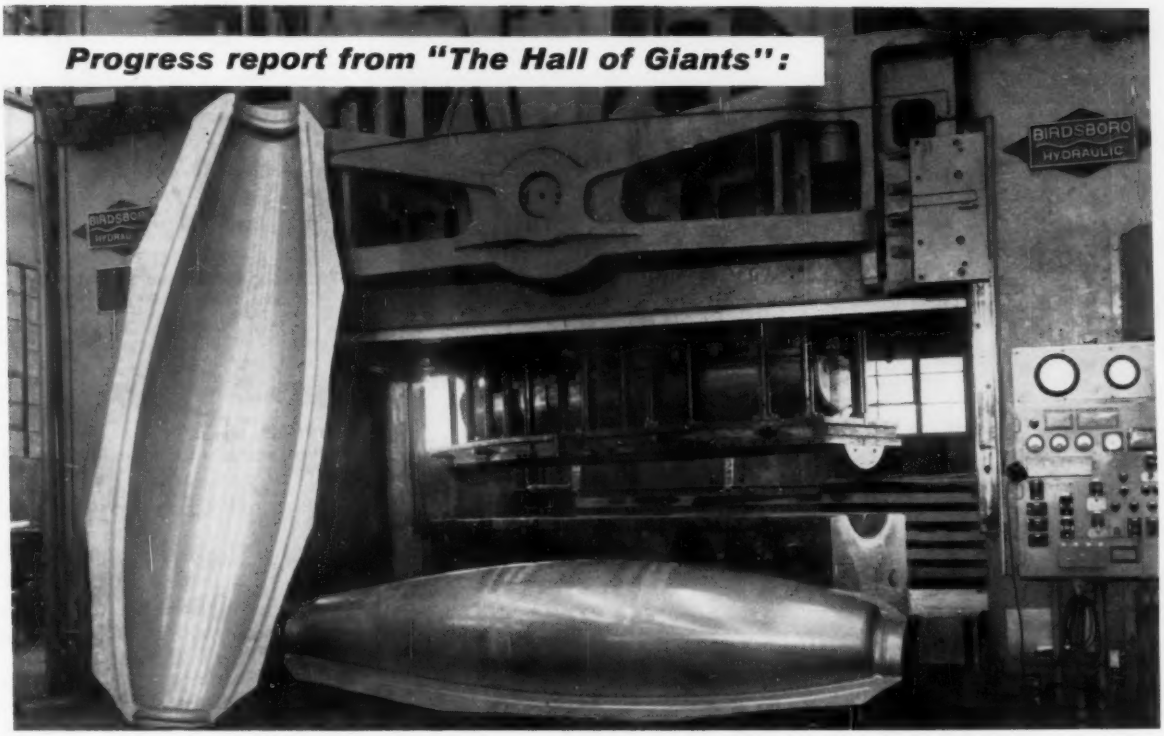
**BAR STOCK AND SHAFTING, Steel**

Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

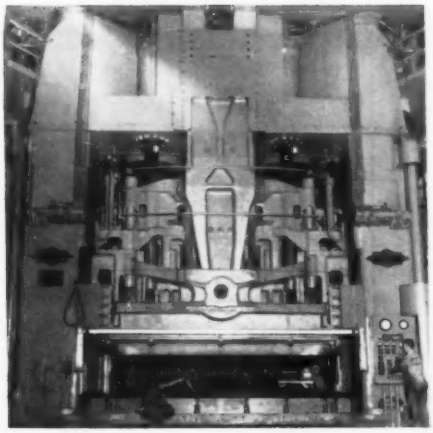
**BEARING PILLOW BLOCKS AND CARTRIDGES**

Bearings, Inc., 3634 Euclid Ave., Cleveland, Ohio
Fafnir Bearing Co., New Britain, Conn.

**Progress report from "The Hall of Giants":**




*versatile* **BIRDSBORO** *8000-ton press now serving 6th trouble-free year at* ***LOCKHEED***



• Lockheed trims excess weight from high speed planes by forming larger sections, thus lowering the number of rivets and support members needed. Latest example: tip tank halves (for the new "Constellation") shown in the photo above. During most of its performance to date, this Birdsboro 8000-ton hydraulic press has operated around the clock, forming components from tough aluminum alloys, both light and heavy gauges. The "very successful" label the aircraft maker put on this press is typical of the satisfaction traditionally expressed by Birdsboro press users. Birdsboro will appreciate the opportunity to work with you on your press projects.

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HP-37-58

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STEEL MILL MACHINERY • HYDRAULIC PRESSES • CRUSHING MACHINERY • SPECIAL MACHINERY • STEEL CASTINGS • Weldments "CAST-WELD" Design • ROLLS: Steel, Alloy Iron, Alloy Steel

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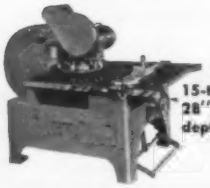
. . . even intricate hole patterns are duplicated at almost unbelievably high speed with Wiedemann Turret Punch Presses—from prototype to medium production runs.

Using the high speed follower gauge, illustrated, openings are pierced in printed wiring boards, chassis, panels, truck and other fabricated parts at rates of 30 to 120 holes per minute. Other rapid gauging methods are also available—assuring you a Wiedemann that suits the size and nature of your work.

High speed operation is just one of the many ways a Wiedemann can cut your short run piercing costs 60% to 90%. Get all the facts. Send drawings of your work for time study and write for Bulletin 301.



RA-41P Wiedemann
15-ton capacity
28" throat depth

*12 to 32 Punches and Dies Ready for Use*

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TURRET PUNCH PRESSES

Other models from 4 to 150 tons

4205 Wissahickon Ave. Philadelphia 32, Pa.

**BEARINGS, Ball**

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Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Boston Gear Works, 3200 Main St., North Quincy, Mass.
Fafnir Bearing Co., New Britain, Conn.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Nice Ball Bearing Co., 30th & Hunting Park Ave., Philadelphia, Pa.
Norma-Hoffmann Bearings Corp., Stamford, Conn.

**BEARINGS, Bronze and Special Alloy**

Boston Gear Works, 3200 Main St., North Quincy, Mass.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio

**BEARINGS, Needle**

Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio

**BEARINGS, Oilless**

Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

**BEARINGS, Roller**

Ball & Roller Bearing Co., Danbury, Conn.
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Norma-Hoffmann Bearings Corp., Stamford, Conn.
Rollway Bearing Co., Inc., 541 Seymour St., Syracuse, N. Y.
Timken Roller Bearing Co., Canton, Ohio

**BEARINGS, Thrust**

Ball & Roller Bearing Co., Danbury, Conn.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Fafnir Bearing Co., New Britain, Conn.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Nice Ball Bearing Co., Nicetown, Philadelphia, Pa.
Norma-Hoffmann Bearings Corp., Stamford, Conn.
Rollway Bearing Co., Inc., Syracuse, N. Y.
Timken Roller Bearing Co., Canton, Ohio

**BELT SANDERS**—See Grinding Machines, Abrasive Belt

**BENCH CENTERS**

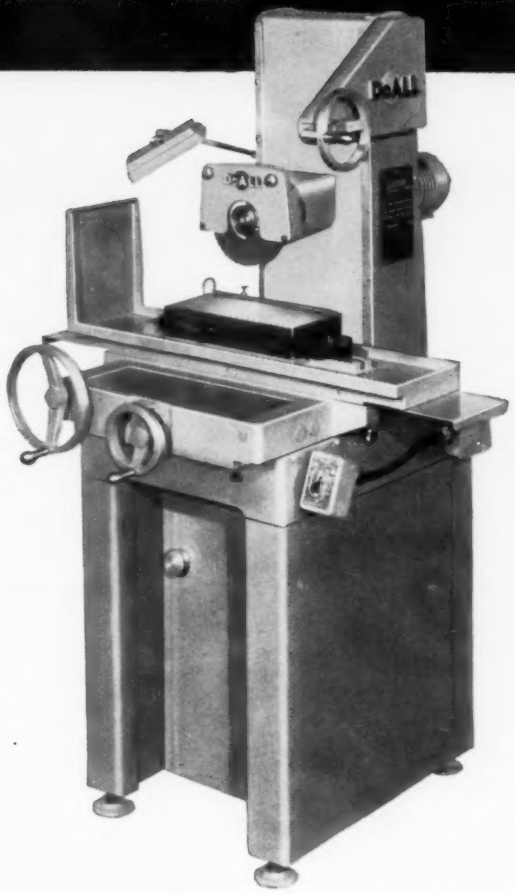
Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

**BENDERS, Bar, Tube, Channel, etc.**

Greenlee Bros. & Co., 2136—12th St., Rockford, Ill.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

# DoALL Announces . . .

## a *NEW* Super Precision Hand-Operated SURFACE GRINDER




***Tailored to Fit the Operator for Easier, More Productive Work***

- **NEW-DESIGN VERTICAL FEED HANDWHEEL** in easy-to-reach, safe position
- **ADJUSTABLE MACHINE OPERATING HEIGHT**
- **SMOOTH TABLE ACTION**—manual traverse through timing belt drive (hydraulic drive optional)
- **RIGHT- or LEFT-HAND TABLE DRIVE**—handwheel position instantly interchangeable
- **VERTICAL HANDWHEEL** graduated in tenths (Zero Slip Rings optional)
- **SADDLE LOCK** for form and plunge grinding
- **1 H.P. MOTORIZED SUPER PRECISION SPINDLE** with anti-friction bearings
- **KNEE-RECESSED** cabinet base

"Human Engineering" guided DoALL engineers in the design of this new surface grinder. Low in cost yet superior in accuracy, it is manufactured to set completely new performance standards in a hand-operated surface grinder.

Every design feature and control function was carefully considered for the operator's convenience. Now the most exacting work may be turned out with least operator fatigue. With tolerances closer than ever before, this assures users of the Model DH-612 a definite competitive advantage.

Standard machine includes not only the exclusive features above, but also telescoping dust guards and one-shot lubrication system to table, saddle, column ways, elevating screw, gears and bearings. A full range of optional accessories is available including "Cool Grinding" through-the-wheel mist coolant system. Table travel is 7″ x 13″; work height, 0 to 12¾″; vertical feed to .0001″ and crossfeed with vernier to .0002″.

In ease of operation, accuracy, power and completeness, there is no finer grinder. Full details are at your DoALL Store—or write . . .

THIS IS A TYPICAL DoALL STORE

THE DoALL COMPANY, Des Plaines, Illinois

GR-26

MACHINE TOOLS ..... CUTTING TOOLS ..... MEASURING INSTRUMENTS ..... SHOP SUPPLIES IN STOCK

# CDT can help you cut costs

**CDT CAN INCREASE YOUR PRODUCTION**
. . . because CDT specializes in designing and building tools and machines for today's high production demands.

**CDT CAN IMPROVE YOUR QUALITY**
. . . because CDT tools, jigs, fixtures and machines are precision engineered and built to the strictest requirements.

**CDT CAN LOWER YOUR PRODUCTION COSTS**
. . . by increasing the efficiency of your operation with special tools that do the job better—faster—more economically.

Call on Columbus Die-Tool for your special tooling problems. A large creative engineering staff with experience in developing special tools and machines for hundreds of industries is at your service. Over 50,000 square feet filled with precision production equipment enables us to build fine tools and special purpose machines to exacting requirements. Avail yourself of the industry-wide experience of Columbus Die-Tool.

**FREE:** *New brochure listing facilities, equipment, etc. Write today.*

Columbus Die-Tool
AND MACHINE COMPANY
P.O. BOX 750 • COLUMBUS, OHIO
ESTABLISHED 1906

*Designers and manufacturers of* JIGS • FIXTURES • SPECIAL TOOLS • UNITS FOR MACHINE TOOLS • *also Builders of Machine Tools Complete*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Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

**BENDING MACHINES, Hydraulic**
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Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Chambersburg Engrg. Co., Chambersburg, Pa.
Hannifin Corp., 501 Wolf Rd., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Engrg. Corp., Kenmore Sta., Buffalo, N. Y.
Niagara Machine & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

**BENDING MACHINES, Pipe**
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Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

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Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

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**BLOWERS**
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Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Northwestern Tools, Inc., 115 Hollier Ave., Dayton 3, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place Jersey City 2, N. J.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.

**BOOKS, Technical**
Industrial Press, 93 Worth St., New York 13, N. Y.

**BORING BARS**
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Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Kennametal Inc., Latrobe, Penna.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.

(*Continued on page 246*)

THIS IS A
TYPICAL DoALL STORE

Machines and Blades Surface Grinders Power Saws
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Rollway Maximum Bearings are used in the McDonnell Voodoo Jet

Gunned by higher speeds and higher temperatures, the performance demand for anti-friction bearings rises sharply every year. Here at Rollway, we strive always to keep abreast of the trend, and even to anticipate it. In precision, dimensional stability and simplicity, Rollway Maximum Bearings offer performance based on advanced thinking to original equipment and replacement buyers of today.

Start now, up-grade both your production machinery and your products with Rollway *bearings of the future*. Rollway Bearing Company, Inc., Syracuse 4, N. Y. Manufacturers of a complete line of radial and thrust cylindrical roller bearings.

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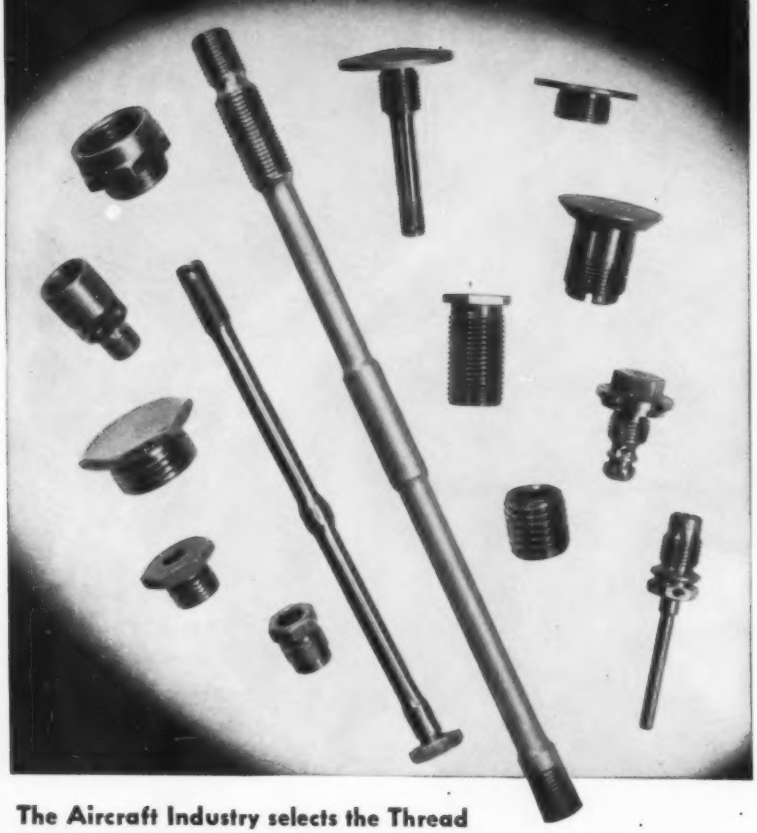
For more information fill in page number on Inquiry Card, on page 197

# Rolling Precision Aircraft Parts on REED Cylindrical Die Thread Rollers



**The Aircraft Industry selects the Thread Rolling Process as the preferred method of threading aircraft parts.**

Thread rolling reproduces the precision thread form of the thread rolling dies and maintains the original accuracy of the setup over long runs.

The cold forging action of thread rolling produces a thread that is substantially stronger and tougher than similar threads produced by other processes.

*Send us specifications of your requirements and let us supply you with complete information.*

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THREAD ROLLING MACHINES and DIES • KNURLS • THREAD ROLLS
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TE-023


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Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio
Wesson Co., 120 Woodward Heights Blvd., Detroit 20, Mich.

### BORING HEADS

American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Bridgeport Machines, Inc., 500 Lindley St., Bridgeport 6, Conn.
Bryant Chucking Grinder Co., Clinton St., Springfield, Vt.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio.
Universal Engineering Co., Frankenmuth 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

### BORING MACHINES

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio.
Bullard Co., Bridgeport 6, Conn.
Canton Tool Mfg. Co., E. Canton, Ohio
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N.Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Davis & Thompson Co., 4460 N. 24th St., Milwaukee 10, Wis.
DeVlieg Machine Co., Ferndale, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray Co., G. A., 3611 Woodburn Ave., Cincinnati 7, Ohio.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Jones & Lamson Machine Co., Springfield, Vt.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Olofsson Corp., Lansing, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Snyder Tool & Engrg. Co., 3400 E. Lafayette St., Detroit 9, Mich.
Wales-Strippit Co., Akron, N. Y.

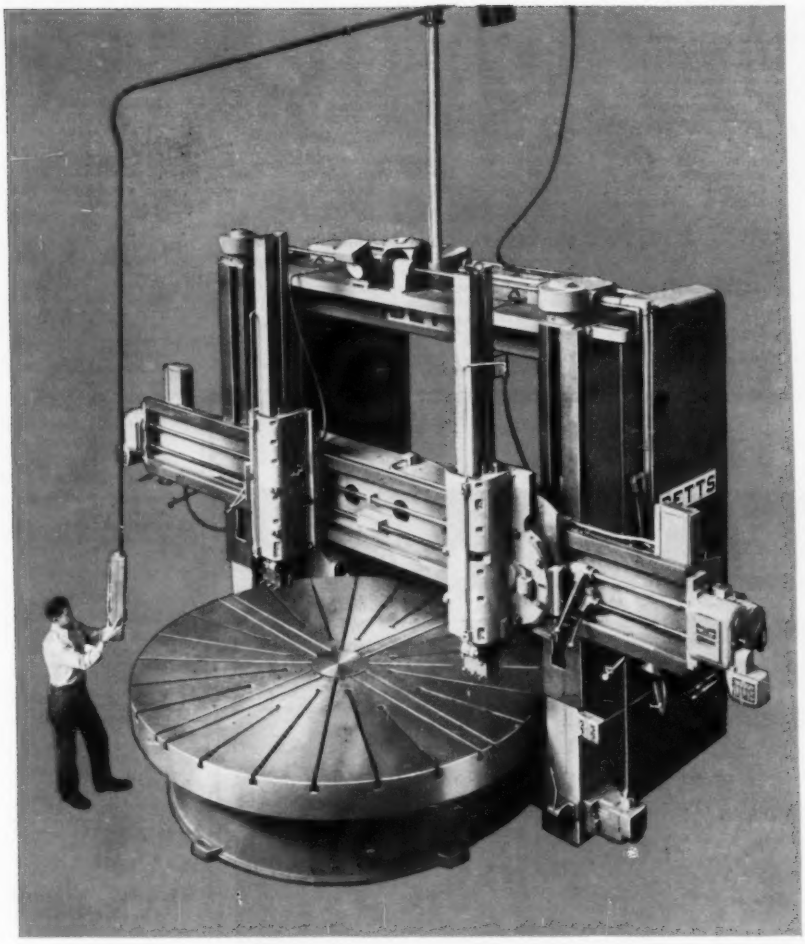
### BORING MILLS, Horizontal

American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., 450 Fair Ave., Ferndale, Detroit 20, Mich.
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., 3611 Woodburn Ave., Cincinnati 7, Ohio.
Lucas Mch. Tool Div., New Britain Mch. Co., 12302 Kirby Ave., Cleveland 8, Ohio.
New Britain Mch. Co., New Britain, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.

### BORING MILLS, Vertical

American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.

(*Continued on page 248*)



# ACCURACY

## *plus ease of operation... in a 12-foot boring mill*

The Betts® 12′ vertical boring mill is just what your production operation needs. This machine brings a new degree of accuracy, convenience and capacity to boring and turning jobs.

The new Betts mill is designed to give you simplicity of operation. Simplified controls reduce maintenance and provide smooth, uncomplicated performance. It's rugged too. Steel rams and replaceable bronze liners give the added degree of rigidity necessary for those tough production runs. This is typical of the keen attention to construction details found in every Betts mill.

The table turns on an antifriction bearing, a construction that requires less power and enables you to handle heavier work loads. It is arranged for variable - voltage, adjustable - speed motor drive. Feed rate is .003″ to .500″ per revolution of table. Speeds range up to 36 RPM. Other drive arrangements and ranges of feeds and speeds are available.

For precision work, you need precision machinery. On your next mill requirement . . . investigate this new Betts or select the size you need from industry's widest range of mills . . . 100″ to 42′.

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Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
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New Britain Mch. Co., New Britain, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.

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Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Vascolcy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

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Cleveland Crane & Engrg. Co., Wickliffe, Ohio.
Ferracute Machine Co., Bridgeport, N. J.
Lodge & Shipley Co., Hamilton 1, Ohio.
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
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Bridgeport Brass Co., Bridgeport, Conn.
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Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

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Cincinnati Milling and Grinding Mchs., Inc., Cincinnati, Ohio.
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Bridgeport Brass Co., Bridgeport, Conn.
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Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

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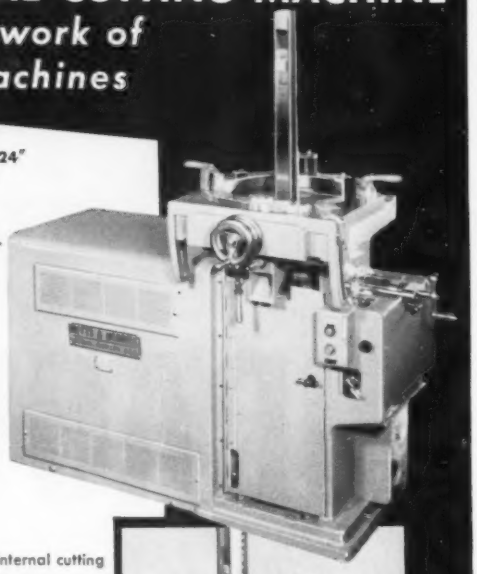
**BURRING MACHINES**—See Deburring Machines

**BURRS**—See Files and Burrs, Rotary


AMAZING NEW HYDRAULIC **M&M** KEYSEATER AND VERTICAL CUTTING MACHINE

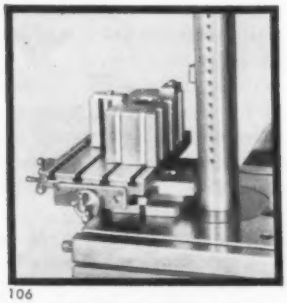
*does the work of many machines*

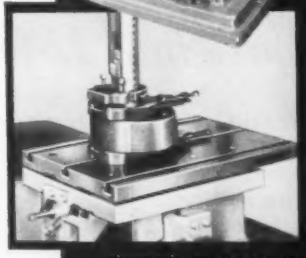
**In addition to a keyseater that cuts internal keyways up to 3" wide x 24" long, the new hydraulic M & M is a handy tool room machine and can be easily adapted to special production jobs other than keyways. A wide variety of internal or external cuts, serrations, grooves and teeth can be rapidly made on this machine. With a combination tilting table and index table (shown on machine at right) straight or tapered bores and accurately spaced multiple keyways or splines may be cut at any degree of the circle. Send us prints of your cutting problems.**



Right: Set-up for internal cutting

Below: Set-up for external cutting





BUILDERS OF MACHINERY SINCE 1854

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**M&M** KEYSEATERS AND VERTICAL CUTTING MACHINES

**MITTS & MERRILL** • 64 Holden St. • SAGINAW, MICHIGAN

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Universal Engrg. Co., Frankenmuth, Mich.

**BUSHINGS, Hardened Steel**
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**BUSHINGS, Non-ferrous and Powdered Metal**
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Starrett, The L. S. Co., Athol, Mass.

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Pratt & Whitney Co., Inc., West Hartford, Conn.
Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

**CAM MILLING AND GRINDING MACHINES**
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Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Landis Tool Co., Waynesboro, Pa.
Rowbottom Machine Co., Waterbury, Conn.

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Eisler Engrg. Co., Inc., 750 S. 13th, Newark 3, N. J.
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
Rowbottom Machine Co., Waterbury, Conn.

**CARBIDES**
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DoAll Co., Des Plaines, Ill.
Linde Co., 30 E. 42nd St., New York 17, N. Y.
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

**CASTINGS, Die**
American Brass Co., Waterbury 20, Conn.
Madison-Kipp Corp., Madison, Wis.

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Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Pittsburgh Brass Mfg. Co., 3199 Penn Ave., Pittsburgh 1, Penna.
Vascoloy-Ramet Corp., Waukegan, Ill.

**CASTINGS—Gray Iron, Malleable**
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Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

**CASTINGS, Steel, Stainless, etc.**
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.

**CEMENT, Abrasive Disc**
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.

**CENTER-DRILLING MACHINES**
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
La Salle Tool Inc., 3840 E. Outer Drive, Detroit 34, Mich.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

**CENTER PUNCHES**—See Machinists' Small Tools


PORTELVATOR®
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A PORTABLE HEIGHT-ADJUSTABLE TABLE
● TRUCK
● WORK BENCH

for
DIE TRANSFER
● MACHINE FEEDING
● ASSEMBLY AT BEST HEIGHT IN BEST LIGHT

LIFTING
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ALL COMPACT HEAVY LOADS

UNOBSTRUCTED PERIMETER
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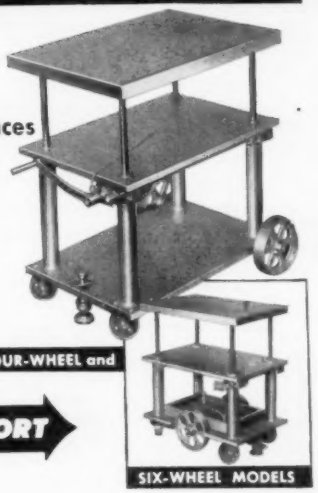
WORK FROM ANY SIDE

MORE SERVICE for LESS MONEY than ANY Other Unit of Equipment

43 table surfaces point support

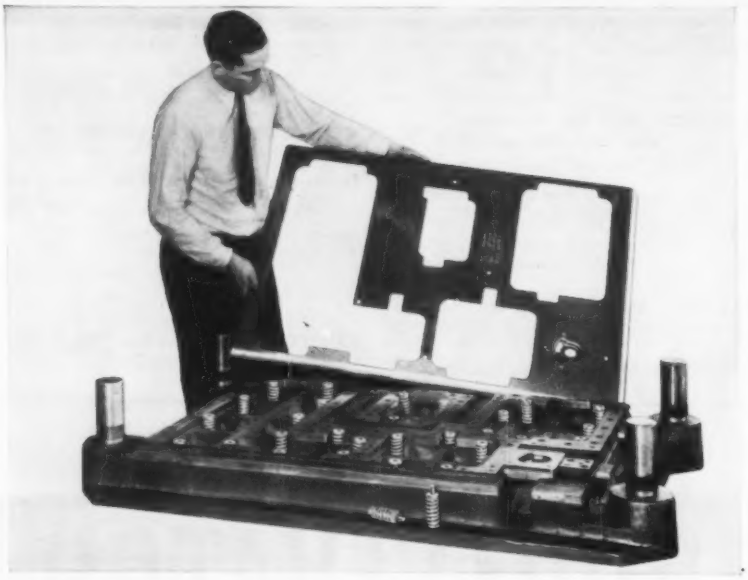



Recent changes and additions to the line provide greater capacities, new flexibility, many bonus features.

Write for NEW, FREE Bulletin P-5604

Address THE HAMILTON TOOL COMPANY,
834 South Ninth Street, Hamilton, Ohio

IT'S A Hamilton Tool
USE IT WITH CONFIDENCE
5604



the **STRIPPIT** that gave us our name...brings you

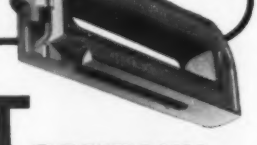
**lower tooling costs!**

**A REVOLUTION IN DIE-MAKING.** The famous "Strippit," invented by Wales Strippit Company, saves tool engineers and die-makers endless hours of designing and building stripping mechanism into die sets. These compact, telescoping spring-and-retainer units provide standardized stripping pressures for uniform stripping of blanks from dies. Strippits eliminate spring grinding . . . stripper bolts . . . drilling and counterboring for stripper bolts . . . boring spring pockets . . . permit use of thinner, easier-to-machine stripper plates . . . eliminate turning over the punch holder and die shoe castings after the back sides have been planed. Strippits pay for themselves many times over on every job.

**LOWER COST MULTIPLE PIERCING AND NOTCHING.**

Strippit self-contained hole punching and notching units, provide the most economical way to notch up to ⅛" mild steel and punch flats, structurals and extrusions up to ¾" mild steel. These units are quickly set up in any pattern, placed in the press without loss of press time and actuated by the ram. Interchangeable standard or special tools . . . fast setup changes . . . re-usability of all units . . . give you high production plus flexibility for quick, economical design changes. Write today for complete engineering details and if you desire, a demonstration by a Strippit mobile unit at your plant. No obligation, of course.

Warehouse stocks in Chicago and Los Angeles.



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Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

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Cone Automatic Mch. Co., Inc., Windsor, Vt.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Goss & DeLeeuw Mch. Co., Kensington, Conn.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Olofsson Corp., 2729 Lyons Ave., Lansing, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

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Jones & Lamson Mch. Co., Springfield, Vt.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Potter and Johnston Co., 1027 Newport Ave., Pawtucket, R. I.
Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 83, Ohio.

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Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Schrader's Son, A., 470 Vanderbilt Avenue, Brooklyn, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

**CHUCKS, Collet**

Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Cushman Chuck Co., 800 Windsor St., Hartford 2, Conn.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Errington Mech. Lab. Inc., 24 Norwood Ave., Staten Island 4, N. Y.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jacobs Mfg. Co., West Hartford 10, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio.
Universal Engrg. Co., Frankenmuth 2, Mich.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

# only *Lapmaster* would guarantee a flatness of ±.00005″ on parts weighing 4920 lbs.

Proper functioning of this vital missile tracking equipment required the highest degree of accuracy obtainable in flatness and parallelity on several component parts . . . some of unusual weight and size. Of all the precision machine tool manufacturers asked to submit recommendations and quotations, only the Lapmaster Division of Crane Packing Company would guarantee to meet the tolerances.

Handling large and odd shaped parts was not new to the Lapmaster. Standard Model 84 Lapmasters had long been lapping to flatness within three light bands (.000035″) on large castings. Therefore only a few modifications to the standard Lapmaster 84 were required to take care of the 4920 lb. 84″ diameter weldment (see job data).

This job also required a machine with the versatility to handle a variety of small parts as well as the big ones. This customer found—as hundreds of users have—that size, shape or form is no problem to a Lapmaster.

On any job—flatness of the lap plate is continuously maintained by the patented reconditioning action of the conditioning rings.

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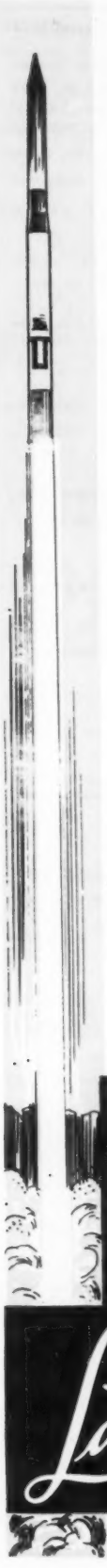
## JOB DATA

**THE PARTS:** Several component parts of a tracking antenna for a long-range radar system. Largest was weldment weighing 4,920 lbs. and measuring 84″ in diameter with bearing lands of 48″ O.D. x 46″ I.D. and 14″ O.D. x 12″ I.D. (see photo).

**THE SPECIFICATIONS:** Flatness and parallelity had to be held to ±.00005″ with bearing lands lapped on the same plane. Faces on mating part are also being lapped to the same specifications.

**THE MACHINE:** Standard Lapmaster Model 84 equipped with an 85″ O.D. x 10″ I.D. lap plate. Special roller bar with simple mountings and fixtures to control position of the odd shaped parts during lapping.



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In Canada: Crane Packing Company, Ltd., Hamilton, Ont.

For more information fill in page number on Inquiry Card, on page 197

# WHY Pratt & Whitney MICROHONES Bores In Titanium Spacers

Rotor disc spacers, that are used in jet engines, require accurate bores having consistent surface finish. Thus, the final processing method must generate bores with diametric and geometric accuracies within .0005" and consistent finishes of 15 microinches.

But, Pratt & Whitney Aircraft Division, U.A.C., faced additional problems in selecting the final processing method for these .110" length bores in titanium spacers. Because the spacers are manufactured in 20 different heights and bores in two diameters, efficient production demanded extreme versatility of the processing method used.

Here's why Pratt & Whitney chose the Microhoning process and equipment to economically produce the required results: Microhoning, in removing .004" of stock from each bore, accurately holds to size and finish requirements; and because the fixturing positions all 20 spacer heights at same work level, the tool stroke never needs adjustment. The Microhoning of all 16 bores in each titanium spacer is completed in about 7 minutes (including loading and unloading time).

Learn why Microhoning will give efficient stock removal, closer tolerances, accurate alignment and functional surfaces.

☐ Please have a Micromatic Field Engineer call.
☐ Please send Micromatic literature and case histories.

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COMPANY _____

STREET _____

CITY _____ ZONE ____ STATE _____ L

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Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

**CHUCKS, Compensating**
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

**CHUCKS, Drill, Key Type**
Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Jacobs Mfg. Co., West Hartford, Conn.

**CHUCKS, Drill, Keyless**
Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Jacobs Mfg. Co., West Hartford, Conn.

**CHUCKS, Full Floating**
Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y.
Gisholt Mch. Co., Madison 10, Wis.
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.
Universal Engineering Co., Frankenmuth 2, Mich.

**CHUCKS, Gear**
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Supreme Products, Inc., 2222 S. Calumet Ave., Chicago 16, Ill.

**CHUCKS, Independent**
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

**CHUCKS, Lathes, etc.**
Bullard Co., Brewster St., Bridgeport 2, Conn.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Horton Chuck, Windsor Locks, Conn.
Jacobs Mfg. Co., West Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio.

**CHUCKS, Magnetic**
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DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Walker, O. S. Inc., Worcester, Mass.

**CHUCKS, Power Operated**
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Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

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National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio.

Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Universal Engineering Co., Frankenmuth 2, Mich.

**CHUCKS, Ring Wheel**
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gardner Mch. Co., 414 E. Gardner St., Beloit, Wis.

**CHUCKS, Tapping**
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y.
Jacobs Mfg. Co., West Hartford, Conn.
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.

**CHUCKS, Universal Three-Jaw**
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Gisholt Mch. Co., Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

**CHUCKS, Wrenchless**
Gisholt Mch. Co., Madison 10, Wis.

**CLAMPS, "C", Toggle, Toolmakers' Parallel**—See Set-Up Equipment

**CLEANERS, Metal**
Oakite Products, Inc., 26 Rector St., New York, N. Y.

**CLUTCHES**
Cleveland Punch & Shear Works, Co., 3917 St. Clair Ave., Cleveland 14, Ohio.
Dynamatic Div. Eaton Mfg. Co., Kenosha, Wis.
Minster Mch. Co., Minster, Ohio.

**COLD HEADING**
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National Machinery Co., Tiffin, Ohio

**COLLETS**—See Chucks, Collet

**COLLOIDAL GRAPHITE**
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**COMBINATION SQUARES**—See Machinists' Small Tools

**COMPARATORS, Dial, Electronic and Air**
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Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 883, Dayton 1, Ohio.
Starrett, L. S., Co., Athol, Mass.

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DoAll Co., 54 Laurel Ave., Des Plaines, Ill.
Eastman Kodak Co., Rochester, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Opto-Metric Tools, Inc., 137 Varick St., New York 13, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

**COMPOUNDS, Cleaning**—See Cleaners, Metal

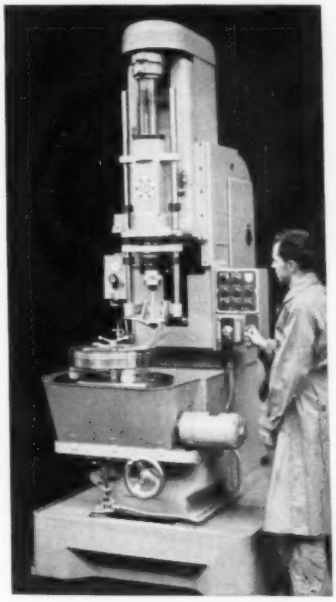
**COMPOUNDS, Cutting, Grinding, Metal Drawing, etc.**—See Cutting and Grinding Fluids

*(Continued on page 254)*


# HOW Pratt & Whitney MICROHONES Bores In Titanium Spacers

By Microhoning the bores in rotor disc spacers used in jet engines, Pratt & Whitney obtains final stock removal that efficiently produces close diametric and geometric accuracies (within .0005") and consistent surface finishes of 15 microinches.

Here's how a Hydrohoner produces these accurate results in 20 different sizes of titanium spacers . . . each spacer having 16 bores that are either .680" or .590" in diameter and .110" in length.



The Hydrohoner is equipped with precise feed and sizing controls that automatically expand and collapse the tool, compensate for abrasive wear, and terminate the Microhoning cycle when required bore size is reached. Also, because fixturing is designed to position all spacers at the same work level, the tool stroke never needs adjustment.

A rotary indexing table automatically locates each bore under the spindle and stops the Hydrohoner when all 16 bores in each spacer are finished. A lateral indexing feature positions the fixture to accommodate various spacer sizes. In fixture change-over, no special tools are required for simple exchanging of four details, and the switch from one spacer size to another requires but a few minutes.

☐ Please send me your movie "Progress in Precision" in time for showing on _____ (date).
☐ Please have a Micromatic Field Engineer call.
☐ Please send Microhoning literature and case histories.

NAME _____
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Wilson, K. R., Inc., Arcade, N. Y.

**CONTOUR FOLLOWER**—See Tracing Attachments

**CONTRACT WORK**
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Bliss, E. W., Co., 1375 Raff Rd., S. W., Canton, Ohio.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Eisler Engrg. Co., 750 S. 13th St., Newark 3, N. J.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
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Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Haynes Stellite Div., Union Carbide & Carbon Corp., 30 E. 42nd St., New York, N. Y.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio.
National Twist Drill & Tool Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

**COUNTERS**
Starrett, The L. S., Co., Athol, Mass.

**COUPLINGS**
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Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
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Mueller Brass Co., Port Huron, Mich.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
Walker Co., Inc., O. S., Rockdale St., Worcester, Mass.

**CRANES, Electric Traveling**
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Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

**CUTTERS, Keyseating**
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DoAll Co., Des Plaines, Ill.
Mitts & Merrill, 1009 So. Water St., Saginaw, Mich.
National Twist Drill & Tl. Co., Rochester, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

**CUTTERS, Milling**
Apex Tool & Cutter Co., Inc., Shelton, Conn.
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gorton, George, Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio.
National Twist Drill Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio.
Tomkins-Johnson Co., Jackson, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

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Sinclair Refining Co., 600 Fifth Ave., New York, N. Y.
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DoAll Co., Des Plaines, Ill.
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Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 35, Pa.
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**CUTTING TOOLS**—See Tool Material

**CYLINDERS, Air**
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Tomkins-Johnson Co., Jackson, Mich.

**CYLINDERS, Hydraulic**
Barnes, John S., Corp., 301 S. Water St., Rockford, Ill.
Chicago Pneumatic Tool Co., New York 17, N. Y.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Logansport Machine Co., Inc., Logansport, Ind.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers, Inc., Detroit 32, Mich.
Wilson, K. R., Inc., Arcade, N. Y.

**DEBURRING MACHINES**
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Federal Machine & Welder Co., Overland Ave., Warren, Ohio
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**DIE INSERTS, Carbide**
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Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
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**DIE SINKING MACHINES**—See Milling Machines, Die Sinking, etc.

**DIE STOCKS**—See Stocks and Dies

**DIES, Blanking, Forming, Drawing, Extruding, etc.**
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Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
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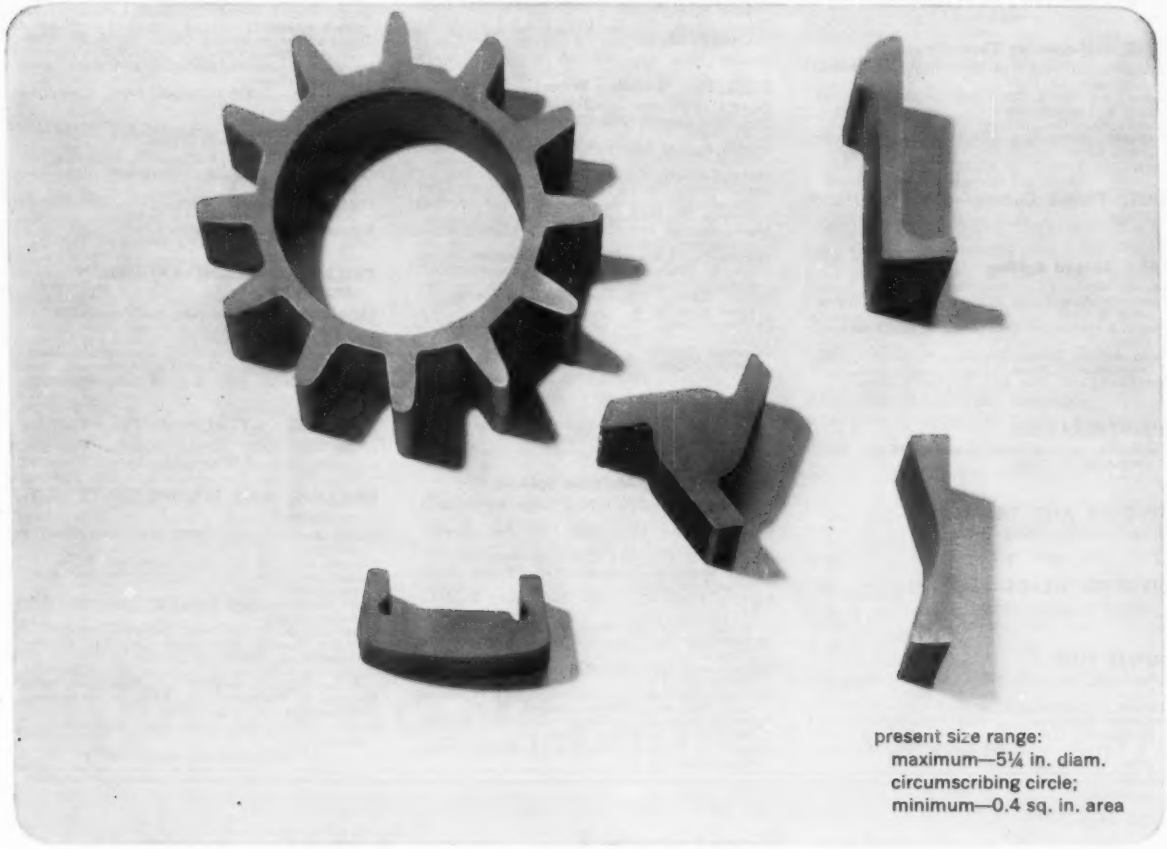

present size range:
maximum—5¼ in. diam. circumscribing circle;
minimum—0.4 sq. in. area

- 316 Stainless
- 304 Stainless
- Tool Steel Atlas 93
- SAE 4130
- 410 Stainless

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If you're hogging out sections, paying for special mill rolls on small orders, or waiting for minimum rolling mill tonnages, Allegheny Ludlum Steel Extrusions are your answer. They will save you scrap loss, slash your machining costs, hold down your inventory requirements and cut delivery time.

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To learn more about the time and cost-cutting possibilities of Allegheny Ludlum Hot Steel Extrusions, send for the extrusion booklet—12-pages of design and engineering information with process and product explanation, material properties, design tips and limitations, tolerances, order instructions, etc. Or call any A-L office for technical assistance. ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*** Address Dept. M-7.

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Export distribution: AIRCO INTERNATIONAL

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Wales-Strippit Corp., North Tonawanda, N. Y.

**DIES, Self-opening Threading**
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio

**DIES, Thread Cutting**—See Stocks and Dies

**DIES, Thread Rolling**
Landis Machine Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Pratt & Whitney Co., Inc., West Hartford, Conn.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio

**DISINTEGRATORS**
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio

**DIVIDERS AND TRAMMELS**—See Layout and Drafting Tools

**DIVIDING HEADS**—See Indexing and Spacing Equipment

**DOWEL PINS**
Allen Mfg. Co., 133 Sheldon St., Hartford 2, Conn.
DoAll Co., Des Plaines, Ill.
Producto Machine Co., 985 Housatonic Ave., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

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Stuart, D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.

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Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Metal Carbides Corp., Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Moore Special Tool Co., Inc., 724 Union Ave., Bridgeport, Conn.
Norton Co., 1 New Bond St., Worcester, Mass.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio

**DRIFT KEYS**
DoAll Co., Des Plaines, Ill.

**DRILL HEADS, Multiple Spindle**
Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Delta Power Tool Div., 400 N. Lexington Ave., Milwaukee 10, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y.
Hartford Special Machinery Co., 387 Homestead Ave., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Leland Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Richmond, Ind.
Snyder Tool & Engrg. Co., 3400 Lafayette, Detroit 7, Mich.
Thriftmaster Products Corp., 1076 N. Plum St., Lancaster, Pa.
United States Drill Head Co., 616 Burns, Cincinnati, Ohio
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

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Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Kingsbury Mch. Tool Corp., Keene, N. H.
Snow Manufacturing Co., Bellwood, Illinois

**DRILL SLEEVES AND EXTENSION HOLDERS**
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Automatic Tool Co., Richmond, Ind.
National Twist Drill & Tool Co., Rochester, Mich.

**DRILLING ATTACHMENTS,** Multiple Spindle—See Drill Heads, Multiple Spindle, and Vises, Machine

**DRILLING AND BORING UNITS, Self-contained**
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Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Buhr Machine Tool Co., 839 Green St., Ann Arbor, Mich.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Leland-Gifford Co., Box 989, Worcester 1, Mass.

(*Continued on page 259*)


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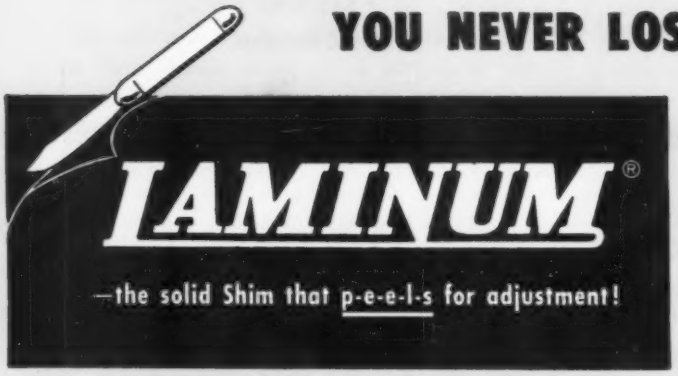


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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Davis & Thompson Co., 4460 N. 124th St., Milwaukee 10, Wis.
Edlund Mchry. Co. Div., Cortland, N. Y.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
Olofsson Corp., Lansing, Mich.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Snow Manufacturing Co., Bellwood, Ill.
Townsend H. P., Mfg. Co., Elmwood, Conn.
Wales-Strippit Corp., Akron, N. Y.
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Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
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Cincinnati Lathe & Tool Co., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Edlund Machinery Co. Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Leland-Gifford Co., Box 989, Worcester, Mass.

### DRILLING MACHINES, Deep Hole

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Ex-Cell-O Corp., 1200 Oakmon Blvd., Detroit 32, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Inc., S. 7th and N. St., Richmond, Ind.
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Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
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Davis & Thompson Co., 4460 124th St., Milwaukee 10, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Edlund Machinery Co. Div., Cortland, N. Y.
Foote-Burt Co., 1300 St. Clair Ave., Cleveland, Ohio
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Greenlee Bros. & Co., 136 12th St., Rockford, Ill.
Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Leland-Gifford Co., Box 989, Worcester, Mass.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
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Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

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American Tool Works Co., Pearl and Eggleston Ave., Cincinnati, Ohio
Carlton Mch. Tool Co., 2961 Meeker St., Cincinnati 25, Ohio
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio
Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio
Cincinnati Lathe & Tool Co., Marburg Ave., Cincinnati 9, Ohio
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Foote-Burt Co., 1300 St. Clair Ave., Cleveland, Ohio
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

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Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Edlund Machinery Co. Div., Cortland, N. Y.
Foote-Burt Co., 1300 St. Clair Ave., Cleveland 8, Ohio
Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
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(*Continued on page 260*)


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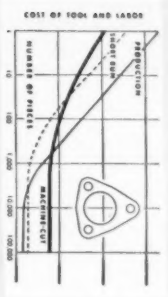


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Cincinnati Lathe & Tool Co., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
LeMaire Tool & Mfg. Co., Dearborn, Mich.
National Automatic Tool Co., Inc., S. 7th and N. St., Richmond, Ind.
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Wales-Strippit Corp., Akron, N. Y.

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DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

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Ace Drill Corp., Adrian, Mich.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Greenfield Tap & Die Corp., Greenfield, Mass.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
National Twist Drill & Tl. Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

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Ace Drill Corp., Adrian, Mich.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tl. Co., Rochester, Mich.

**DRILLS, Oil Hole, Oil Tube**

Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tl. Co., Rochester, Mich.

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Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

**DRILLS, Portable pneumatic**

Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

**DRILLS, Ratchet**

Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tl. Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio

**DRILLS, Subland**

Ace Drill Corp., Adrian, Mich.
Cleveland Twist Drill Co., 1242 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tl. Co., Rochester, Mich.

**DRILLS, Twist, High-Speed Steel, Carbon Steel**

Ace Drill Corp., Adrian, Mich.
Cleveland Twist Drill Co., 1242 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

**DRILLS, Twist, Carbide, Carbide-Tipped**

Ace Drill Corp., Adrian, Mich.
Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
National Twist Drill & Tool Co., Rochester, Mich.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

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Ace Drill Corp., Adrian, Michigan
Cleveland Twist Drill Co., Cleveland, O.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio

**DUPLICATING ATTACHMENTS**—See Tracing Attachments

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Brown & Sharpe Mfg. Co., Providence, R. I.
Pangborn Corp., Hagerstown, Md.
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**ELECTRONIC CONTROL SYSTEMS**

Electronic Control Systems, 2231 S. Barrington Ave., Los Angeles 64, Calif.

**ENGRAVING MACHINES**

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Gorton, Geo., Mach., 1321 Racine St., Racine, Wis.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

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Grotnes Machine Wks., Inc., 5454 N. Walcott, Chicago 40, Illinois

**EXTRACTORS, Screw**

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Greenfield Tap & Die Corp., Greenfield, Mass.

**FACING HEADS**

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Cross Co., 3250 Bellevue, Detroit 7, Mich.
Davis Boring Tool Div. Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Mummert-Dixon Co., Hanover, Pa.

**FANS, Exhaust, Ventilating**

Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.

**FASTENERS**

Allen Mfg Co., 133 Sheldon St., Hartford 2, Conn.
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(*Continued on page 262*)


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BETHLEHEM STEEL

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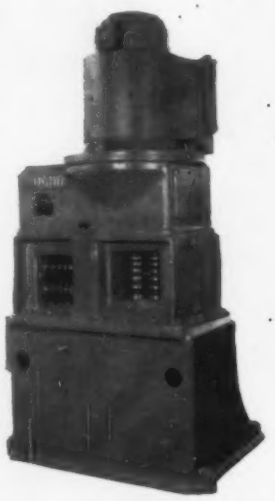

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*(Continued on page 264)*

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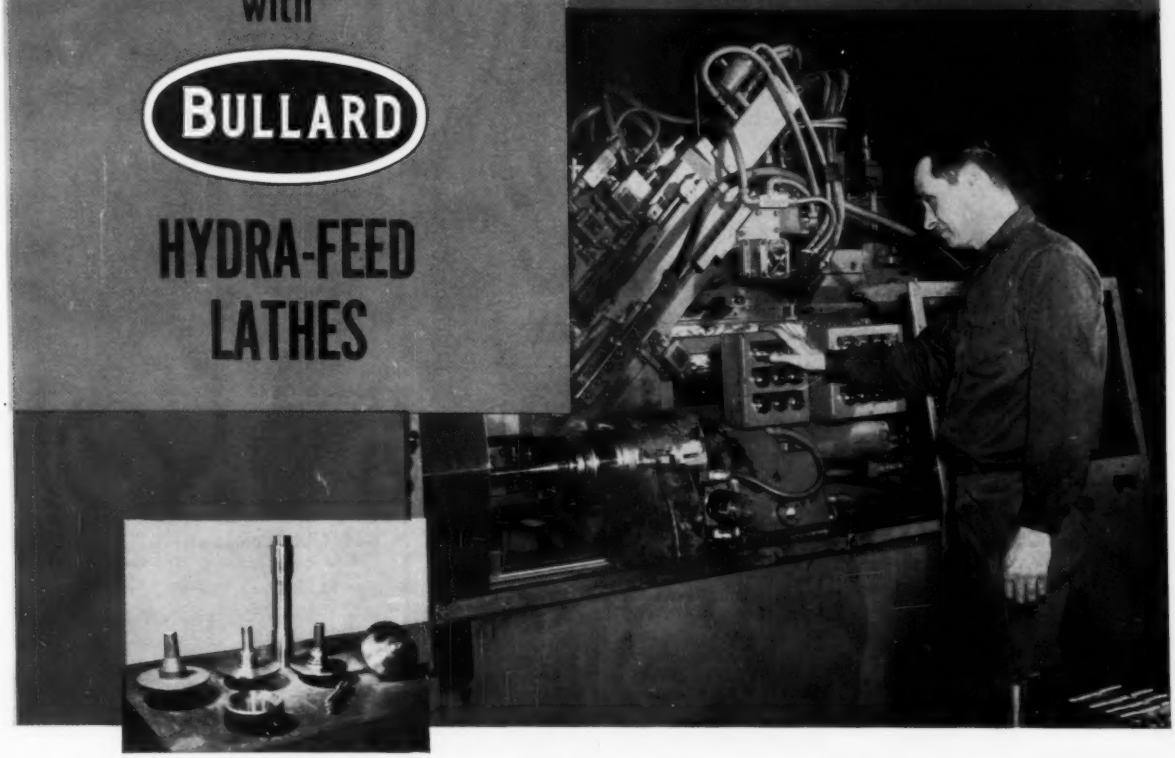

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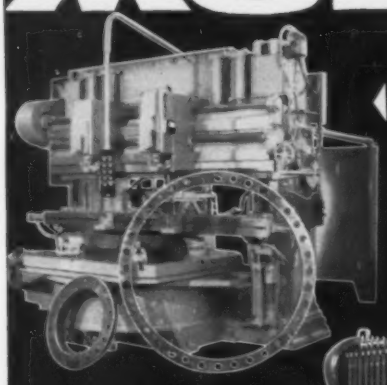

HD68 drills bolt circles from 12" to 100" diameter. Each of the two spindles has capacity for 2½" drill in steel. Operating cycle is fully automatic.

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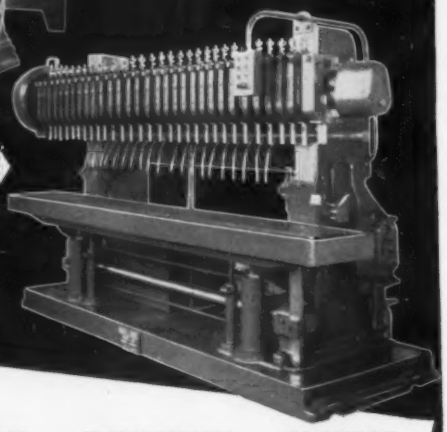

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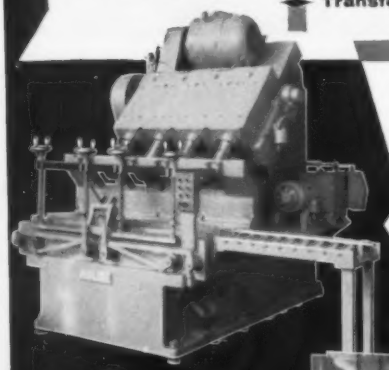

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Chambersburg Engrg. Co., Chambersburg, Pa.
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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
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*(Continued on page 266)*

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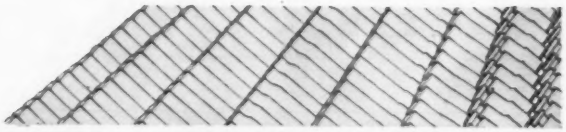
(*Continued on page 268*)

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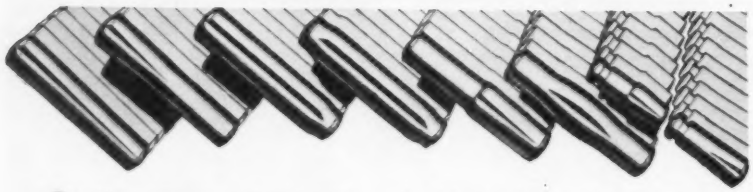

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Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

**GRINDING MACHINES, Centerless**

Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Landis Tool Co., Waynesboro, Pa.

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Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
Landis Tool Co., Inc., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

### GRINDING MACHINES, Disc
Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh 8, Pa.
Gardner Machine Co., Beloit, Wis.
Mattison Machine Works, Rockford, Ill.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

### GRINDING MACHINES, Gear
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gear Grinding Mch. Co., 3901 Christopher St., Detroit 11, Mich.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

### GRINDING MACHINES, Internal
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Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
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Standard Electrical Tool Co. 2488-90 River Rd., Cincinnati, Ohio
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

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Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.

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Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

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Norton Co., 1 New Bond St., Worcester 6, Mass.

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Delta Power Tool Div., 400 Lexington Ave., Pittsburgh, Pa.
DoAll Co., Des Plaines, Ill.
Foote-Burt Co., 13000 St. Clair Ave., Cleveland 8, Ohio
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 4, Mich.
Gardner Machine Co., Beloit, Wis.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Machine Works, Rockford, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio

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Gardner Machine Co., Beloit, Wis.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Mattison Machine Works, Rockford, Ill.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
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Sheffield Corp., Box 893, Dayton 1, Ohio

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(Continued on page 270)

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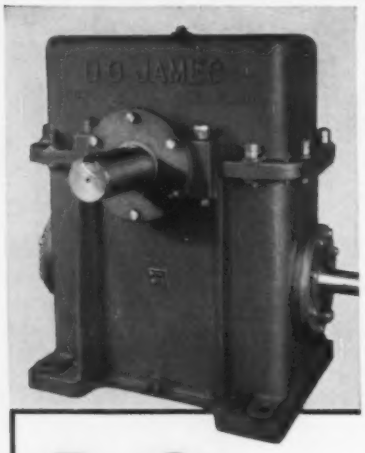

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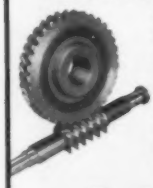

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Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Robbins, Omer E. Co., 24800 Plymouth Rd., Detroit 39, Mich.
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Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
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*(Continued on page 272)*


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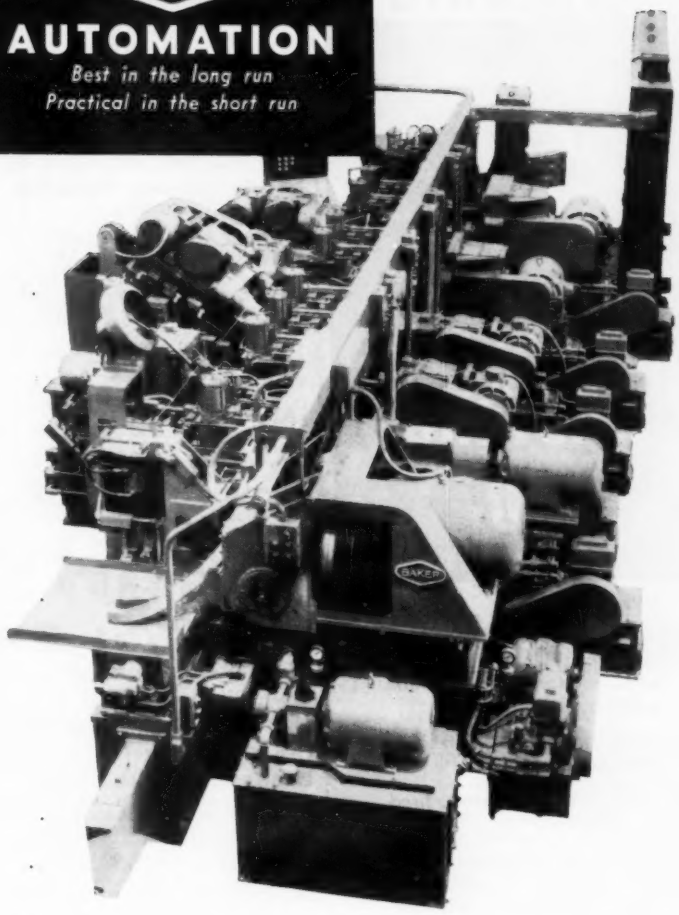

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Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

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Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mcn. Tool Co., 2351 11th St., Rockford, Ill.

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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Hendey Mch. Div., Barber Colman Co., Rockford, Ill.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Hardinge Bros. Inc., 1420 College Ave., Elmira, N. Y.
Hendey Mch. Div., Barber Colman Co., Rockford, Ill.
Leblond, R. K. Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
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Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
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Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton Ohio
Bliss, E. W., Co., Canton, Ohio
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio

**LATHES, Speed, Second-operation**

Atlas Press Co., Kalamazoo, Mich.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., Cincinnati 25, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sheldon Mch. Co., 4258 N. Knox Ave., Chicago 41, Ill.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

**LATHES, Spinning**

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Lodge & Shipley Co., The, Cincinnati 25, Ohio

**LATHES, Toolroom**—See Lathes, Engine, Toolroom

**LATHES, Turret, Automatic**

Atlas Press Co., Kalamazoo, Mich.
Bullard Co., Bridgeport 2, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.

**LATHES, Turret, Ram Type, Saddle Type**

Atlas Press Co., Kalamazoo, Mich.
Bardons & Oliver Inc., Ft. W. 9th St., Cleveland 13, Ohio
Bullard Co., Bridgeport 2, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Brothers, Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
Levin & Son, Inc., Louis, Los Angeles 8, Calif.
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sheldon Mach. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio

**LATHES, Turret Vertical**—See Boring Mills, Vertical

**LAYOUT and DRAFTING TOOLS**

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Lufkin Rule Co., Saginaw, Mich.
Starrett, L. S., Co., Athol, Mass.

*(Continued on page 274)*

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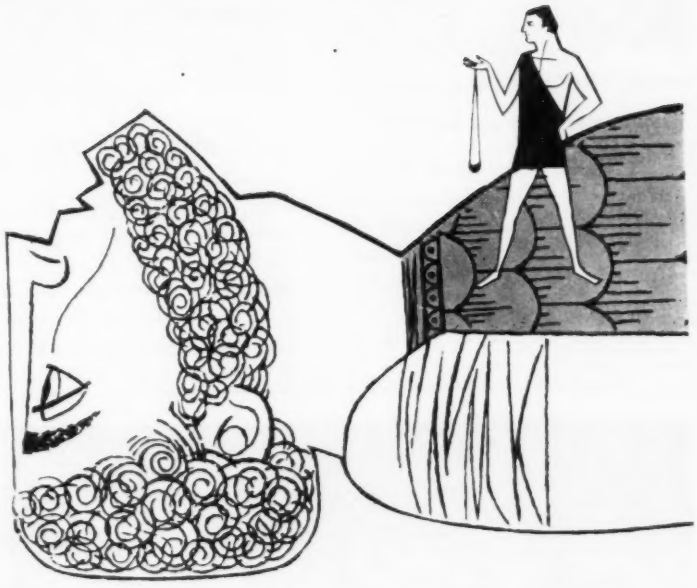

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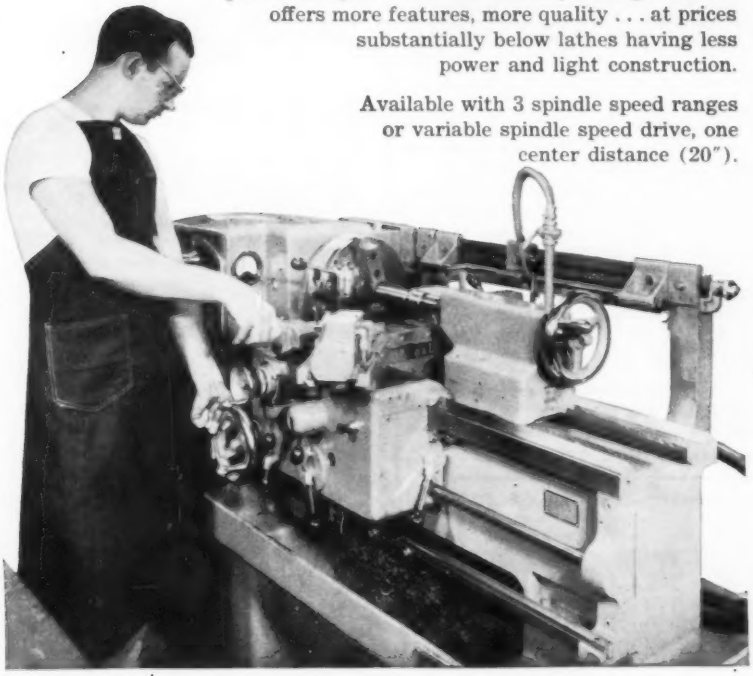

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**Cincinnati 25, Ohio**

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Starrett, The L. S., Co., Athol, Mass.

**LIMIT SWITCHES**—See Switches, Limit

**LUBRICATING OILS and GREASES**
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Cities Service Oil Co., 70 Pine St., New York, N. Y.
Standard Oil Co. (Indiana), 910 S. Michigan, Chicago, Ill.
Stuart D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.
Sun Oil Co., 1608 Walnut St., Philadelphia, Pa.
Texas Co., 135 E. 42nd St., New York, N. Y.

**LUBRICATING SYSTEMS**
Gits Bros. Mfg. Co., 1846 S. Kilbourn Ave. Chicago 23, Ill.
Madison-Kipp Corp., Madison, Wis.

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Van Keuren Co., Watertown 72, Mass.

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Lufkin Rule Co., Saginaw, Mich.
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
Starrett, The, L. S., Co., Athol, Mass.

**MANDRELS**—See Arbors and Mandrels

**MARKING MACHINES and DEVICES**
Gorton Mch. Co., 1321 Racine St., Racine Wis.

**MATERIAL-HANDLING TRUCKS**—See Trucks, Material Handling

**MEASURING MACHINES**
Lufkin Rule Co., Saginaw, Mich.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio
Van Keuren Co., Watertown 72, Mass.

**MEASURING WIRES**—Thread, Spline, Gear
Sheffield Corp., Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Van Keuren Co., Watertown 72, Mass

**MICROMETER HEADS**
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoAll Co., Des Plaines, Ill.
Starrett, The L. S., Co., Athol, Mass.

**MICROMETERS, Outside, Inside, Depth**
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Lufkin Rule Co., Saginaw, Mich.
Scherr, George, Co., Inc., 200 Lafayette St. New York 12, N. Y.
Starrett, The L. S., Co., Athol, Mass.
Van Keuren Co., Watertown 72, Mass.

**MICROSCOPES, Toolmakers'**
Bausch & Lomb Optical Co., Rochester, N. Y.
DoAll Co., Des Plaines, Ill.
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

**MILLING MACHINE ATTACHMENTS**
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches. Inc., 4701 Marburg Ave., Cincinnati 9 Ohio
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Gorton, George Mch. Co., 1140 W. 13th St., Racine, Wis.
Greaves Mch. Tool Div., 2011 Eastern Ave., Cincinnati 2, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14 Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Sheldon Mch. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.

**MILLING MACHINES, Automatic**
Cincinnati Milling Machine Co., Cincinnati, Ohio
Consolidated Machine Tool Corp., Rochester, N. Y.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.
Nichols, W. H. Co., Waltham 54, Mass.
Pratt & Whitney Co., Inc., West Hartford, Conn
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

**MILLING MACHINES, Bed Type, Simplex, Duplex**
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Cincinnati Milling & Grinding Mches., Inc., 470 Marburg Ave., Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Espen-Lucas Mch. Wrks., Front St. and Girard Ave., Philadelphia, Pa.
Kearney & Trecker Corp., 6784 W. National Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

(Continued on page 275)

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Nichols, W. H. Co., Waltham 54, Mass.

### MILLING MACHINES, Circular, Continuous

Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 6411 W. Burnham St., Milwaukee 14, Wis.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
Nichols, W. H. Co., Waltham 54, Mass.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2351 11th St., Rockford, Ill.

### MILLING MACHINES, Die Sinking, Duplicating, Profiling

Arrow Engineering Co., 120 E. Market St., Indianapolis, Ind.
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Colonial-Romulus Div., Parkgrove Station, Detroit 5, Mich.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Gorton, George, Machine Co., 1110 W. 13th St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St. Rockford, Ill.

### MILLING MACHINES, Knee Type, Horizontal, Plain, Universal

Austin Industrial Corp., 76 Mamaroneck Ave., White Plains, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton Geo., Mch., Co., 1110 W. 13th St., Racine, Wis.
Greaves Machine Tool Div., 2009 Eastern Ave., Cincinnati, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheldon Machine Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

### MILLING MACHINES, Knee Type Rise and Fall

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., 42 Exchange Place, Jersey City, N. J.

### MILLING MACHINES, Knee Type Ram

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

### MILLING MACHINES, Knee Type Turret

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.

### MILLING MACHINES, Knee Type, Vertical

Atlas Press Co., Kalamazoo, Mich.
Austin Industrial Corp., 76 Mamaroneck Ave., White Plains, N. Y.
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport, 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 450 Lexington Ave., New York 17, N. Y.
Gorton, George, Mch. Co., 1110 W. 13th St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

### MILLING MACHINES, Planer Type

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., Woodburn Ave. and Penn R.R., Evanston, Cincinnati, Ohio
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sunstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

### MILLING MACHINES, Spar

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Kearney & Trecher Corp., 6784 W. National, Milwaukee, 14, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

(*Continued on page 276*)


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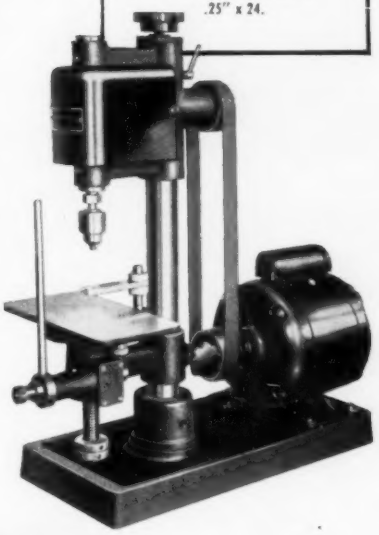
Capacity — .034" x 120 to .25" x 24.



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Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

**MOTORS, Air**
Ingersoll-Rand Co., Phillipsburg, N. J.

**MOTORS, Electric**
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Lincoln Electric Co., Cleveland 17, Ohio
Reliance Electric & Engineering Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio

**MOTORS, Hydraulic**
Barnes, J. S., Corp., Rockford, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hydraulic Press Mfg. Div., Mt. Gilead, Ohio
Oilgear Co., 1569 W. Pierce St.; Milwaukee, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Vickers, Inc., Detroit 32, Mich.

**MULTIPLE INSPECTION GAGES**—See Gages, Multiple Inspection

**MULTIPLE-STATION MACHINES, Dial Type**
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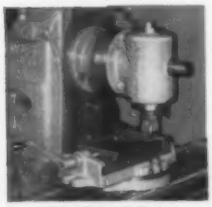
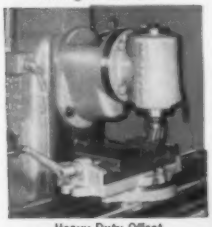
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Baush Mch. Tool Co., 15 Wason Ave., Springfield, Mass.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Federal Prod. Corp., 1144 Eddy St., Providence 1, R. I.



Heavy Duty Vertical Milling Attachment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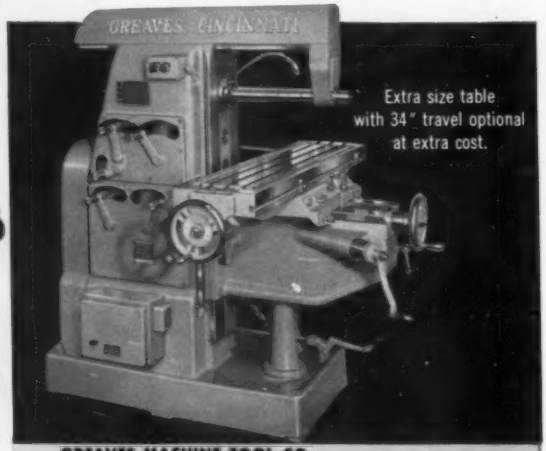


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Buhr Mch. Tool Co., 839 Green St., Ann Arbor, Mich.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling Mch. Co., Cincinnati 9, Ohio
Clearing Mch. Corp., 6499 W. 65th St., Chicago 38, Ill.
Davis & Thompson Co., 4460 N. 124th St., Milwaukee 10, Wis.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Greenlee Bros. & Co., 2136 - 12th St., Rockford, Ill.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
La Salle Tool Inc., 3840 E. Outer Drive, Detroit 34, Mich.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Moline Tool Co., 102-20th St., Moline, Ill.
National Automatic Tool Co., S. 7th N. Sts., Richmond, Ind.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Snyder Tool & Engrg. Co., 3400 E. Lafayette Ave., Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, Ill.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

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**NUTS**—See Bolts, Nuts and Screws

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Madison-Kipp Corp., Madison, Wis.
Wicaco Mch. Corp., Philadelphia, Pa.

**OILS, CUTTING SOLUBLE**—See Cutting and Grinding Fluids

**OILS, Lubricating**—See Lubricating Oils and Greases

**OILS, Quenching and Tempering**
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Sinclair Refining Co., 600 - 5th Ave., New York, N. Y.
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Van Keuren Co., Watertown 72, Mass.

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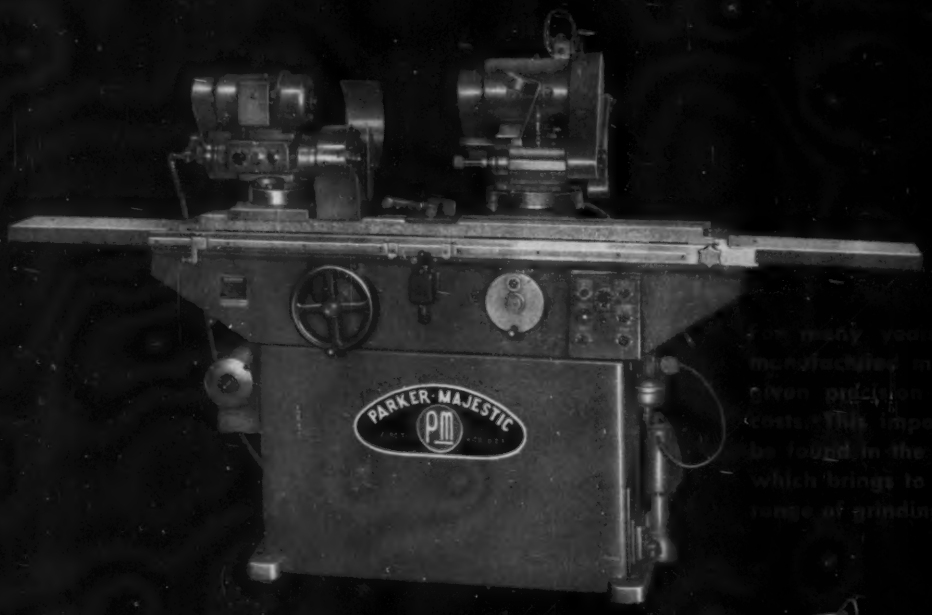


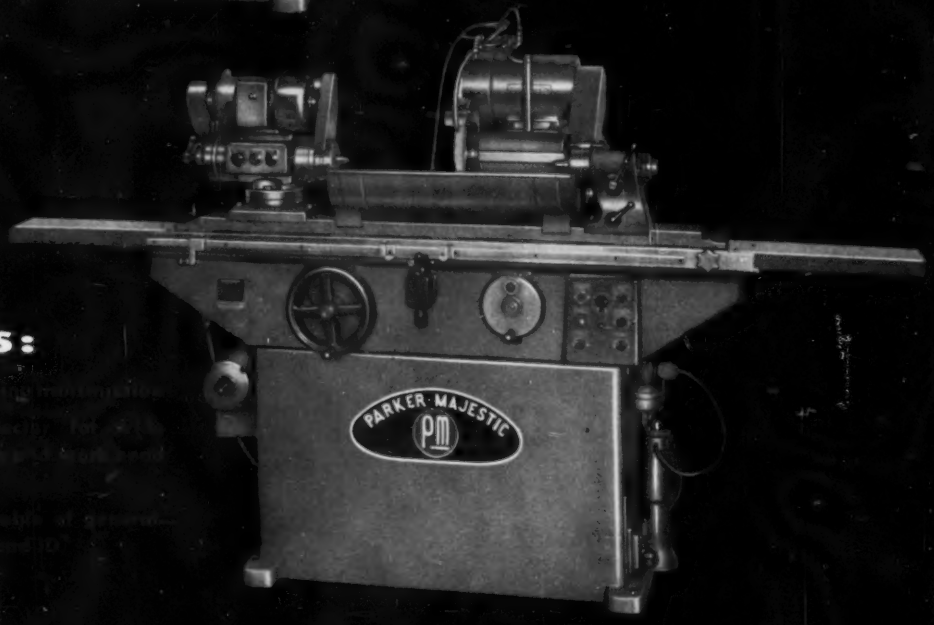


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**PAINTING EQUIPMENT, Spray**—See Spraying Equipment, Metal

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DoAll Co., Des Plaines, Ill.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Starrett, The L. S., Co., Athol, Mass.
Walker, O. S., Co., Inc., Worcester, Mass.

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Bethlehem Steel Co., Bethlehem, Pa.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
United States Steel Corp., National Tube Co., Div., 436 7th Ave., Pittsburgh, Pa.

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**PLANERS, Double Housing and Openside**
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton Ohio
Consolidated Mch. Tool Div., Rochester, N. Y.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A. Co., 3611 Woodburn Ave., Cincinnati, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.

**PLASTICS AND PLASTIC PRODUCTS**
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**PRESS BRAKES**—See Brakes, Press and Bending

**PRESS FEEDER, Automatic**
Bliss E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Nilson, A. H. Machine Co., Bridgeport, Conn.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
U. S. Tool Co., 255 N. 18th St., Ampere, East Orange, N. J.

**PRESSES, Arbor**
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Famco Machine Co., Kenosha Wis.
Logansport Machine Co., Inc., Logansport, Ind.
Threadwell Tap & Die Corp., 16 Arch St., Greenfield, Mass.
Wilson K. R., Inc., Arcade, N. Y.

**PRESSES, Assembling**
Alva Allen Industries, Clinton, Missouri
Bliss E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.

**PRESSES, Blanking, Stamping**
Alva Allen Industries, Clinton, Missouri
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss E. W. Co., 1375 Raff Rd. S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E. Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
U. S. Tool Co., Inc., 255 N. 8th St., Ampere, East Orange, N. J.
V. & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Walsh Press & Die Co., 4709 W. Kinzie St., Chicago 44, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

**PRESSES, Briquetting**
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.

**PRESSES, Closed-Die Forging**
Ajax Manufacturing Co., 1441 Chardon Rd., Cleveland 17, Ohio
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

**PRESSES, Coining, Embossing**
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Bliss, E. W. Co., 1375 Raff Rd., S. W. Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E. Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
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*(Continued on page 280)*


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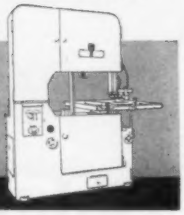

SAWING MACHINERY SPECIALISTS

# For Automatic Feeds • Greater Convenience

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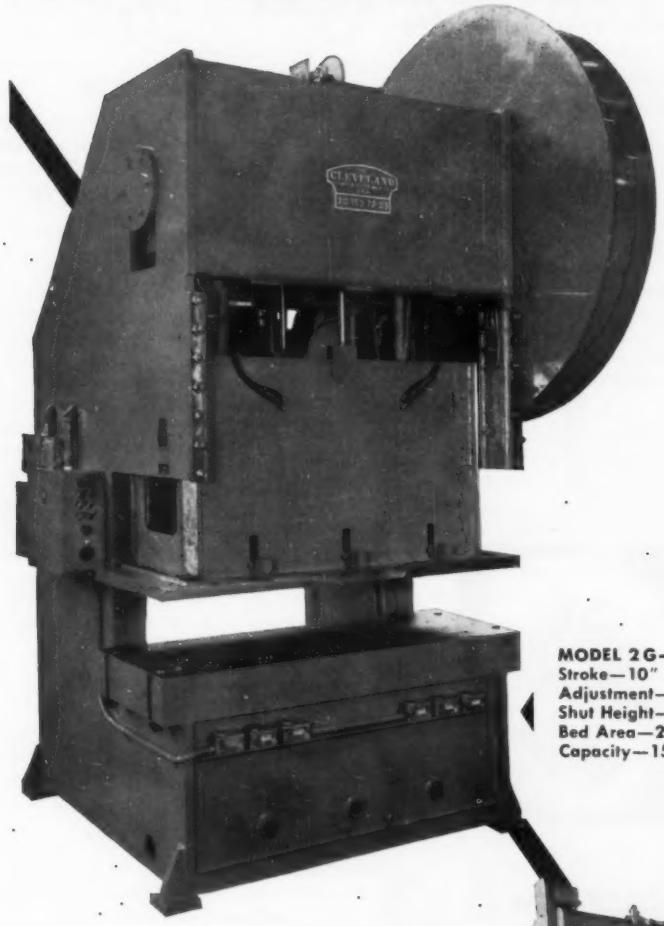

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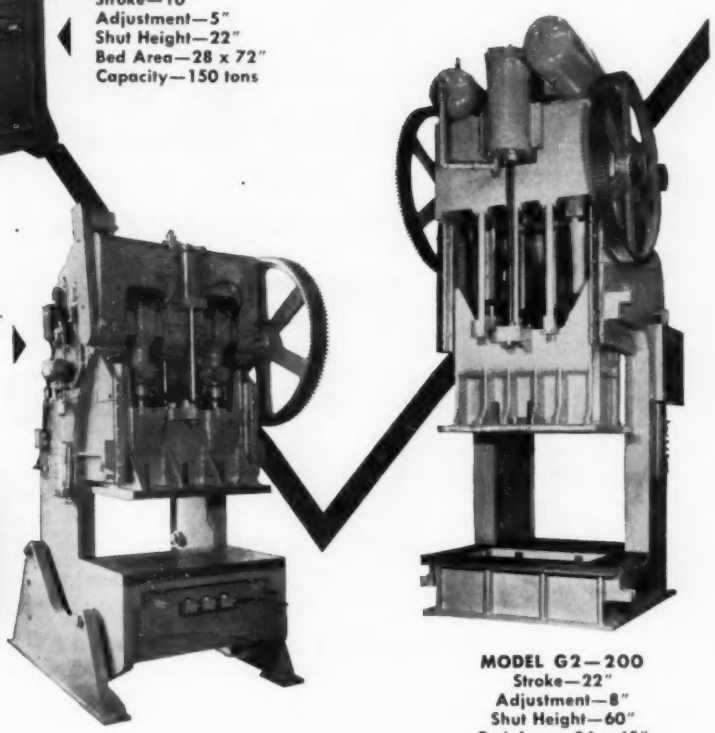
Stroke—10"
Adjustment—5"
Shut Height—22"
Bed Area—28 x 72"
Capacity—150 tons

**MODEL 45G—42—75**
Mounted on legs for inclining.
Stroke—6"
Adjustment—4"
Shut Height—17"
Bed Area—30 x 54"
Capacity—75 tons



**MODEL G2—200**
Stroke—22"
Adjustment—8"
Shut Height—60"
Bed Area—84 x 45"
Capacity—200 tons

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Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

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Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

**PRESSES, Die Tryout**

Bliss, E. W. Co., 1375 Raff Rd., S. W. Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.


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Ferracute Punching Presses. 20 to 105-ton models.

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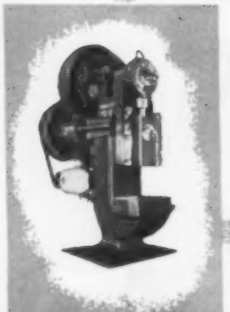

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Cincinnati Milling & Grinding Machines, Inc., 4710 Marburg Ave., Cincinnati 9, Ohio
Clearing Machine Corp., 6399 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

**PRESSES, Extrusion**

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

**PRESSES, Foot**

Famco Machine Co., Kenosha, Wis.
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

**PRESSES, Horning**

Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
V & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

**PRESSES, Notching**

Alva Allen Industries, Clinton, Missouri
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.

*(Continued on page 282)*



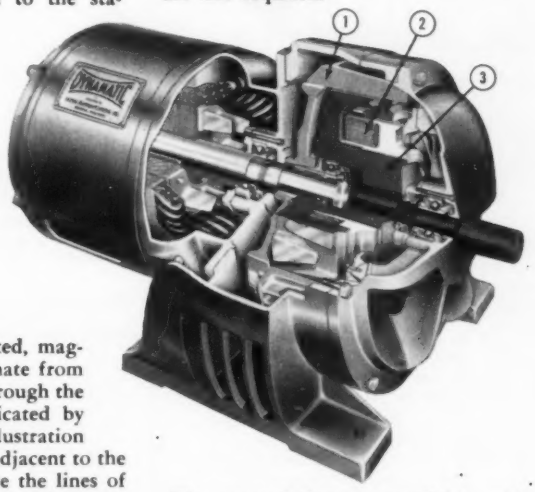
For more information fill in page number on Inquiry Card, on page 197

# HOW DYNAMATIC® Drives Provide Infinitely Adjustable Speed with AC Power

Dynamatic Ajusto-Spede® and Dynaspede® Drives operate from an alternating current power source and are infinitely adjustable from zero RPM to full output speed. Accurate control of output speed is obtained by varying the current in a single field coil.

Each Dynamatic Drive consists of a constant speed AC motor and an eddy-current coupling. Torque developed in the motor is transmitted through the coupling by electromagnetic attraction between its driving and driven members.

The driving member, or drum (1), is mounted on the end of the motor shaft and surrounds the rotor, or driven member (3). The drum is free to rotate independently of the rotor until current is applied to the stationary field coil (2).



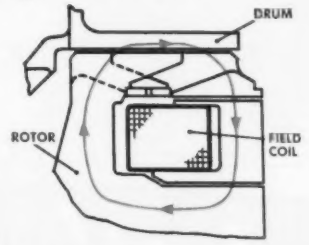

1. Input Drum Assembly
2. Stationary Field Assembly
3. Output Rotor Assembly

As the field coil is excited, magnetic lines of force emanate from the field coil and flow through the rotor and drum as indicated by arrows in cross-section illustration (A). Poles on the rotor adjacent to the smooth drum concentrate the lines of force into localized areas of "high flux" density in the drum's inner surface, shown in illustration (B). As the drum rotates about the rotor, these high flux areas sweep the inner surface of the drum, causing a variation of flux density that generates an eddy-current field in the drum's inner surface. Magnetic attraction between this eddy-current field and the rotor poles causes the rotor to rotate with the drum.

The torque transmitted from the drum to the rotor varies with the current applied to the field coil and with the "slip", or difference in speeds between the drum and rotor. Speed control with eddy-current equipment is obtained with a control system that adjusts field coil current to deliver the required torque at the desired slip.

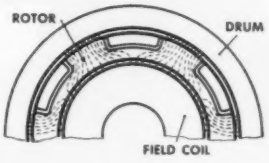
The control systems used with Dynamatic Eddy-Current Equipment operate on alternating current and require no special power source. Because of the low power required for field coil excitation, rectifying of field coil current is easily accomplished electronically. Expensive motor-generator sets are not required.

The control features available with Dynamatic Eddy-Current Equipment include constant speed regulation, acceleration control, torque regulation, cascading of multiple units, inching and threading, and numerous others as required by individual applications. Dynamatic Eddy-Current Equipment is ideally suited to automatic control.



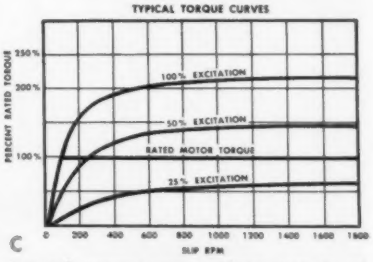

A

**Flow of magnetic lines of force through rotor, drum, and stationary field.**



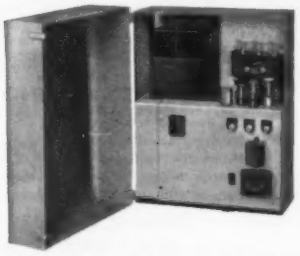

B

**Concentration of magnetic lines of force by the rotor poles.**




C

**Typical torque curves show torque at various values of excitation. The horizontal line is rated motor torque.**



D

**The electronic control systems used with Dynamatic Eddy-Current Equipment do not require a special power source or motor-generator sets.**

*Send for your copy of Bulletin D-582 which gives detailed information on Dynamatic Eddy-Current Equipment.*

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Wilson, K. R., Inc., Arcade, N. Y.

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Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Famco Machine Co., Kenosha, Wis.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood, Chicago 19, Ill.
Wales-Strippit Co., Akron, N. Y.
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Wiedemann Machine Co., 4272 Wissahicken Ave., Philadelphia 32, Pa.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

**PRESSES, Quenching**

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• Flexibility for easy and fast adjustment
• Escapement does not require daily lubrication
• Escapement design permits releasing screws by body or head as required
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• Simple design for easy servicing
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Chambersburg Engineering Co., Chambersburg, Pa.
Cincinnati Milling & Grinding Machines, Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

**PRESSES, Trimming**

Alva Allen Industries, Clinton, Missouri
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

**PROFILING MACHINES**—See Milling Machines, Die Sinking, etc.

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**PULLEYS**

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Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Graymills Co., 3705 N. Lincoln Ave., Evanston, Ill.
Ingersoll-Rand Co., Phillipsburg, N. J.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Ruthman Machinery Co., 1809 Reading Rd., Cincinnati 2, Ohio
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Barnes, John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence R. I.
Denison Engrg. Co., 1160 Dublin St., Columbus Ohio
Elmes Eng. Div., American Steel Foundries 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Div., Mount Gilead, Ohio
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Sundstrand Machine Tool Co., 2531 11th St., Rockford, Ill.
Vickers Incorporated, Division of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich.
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*(Continued on page 284)*

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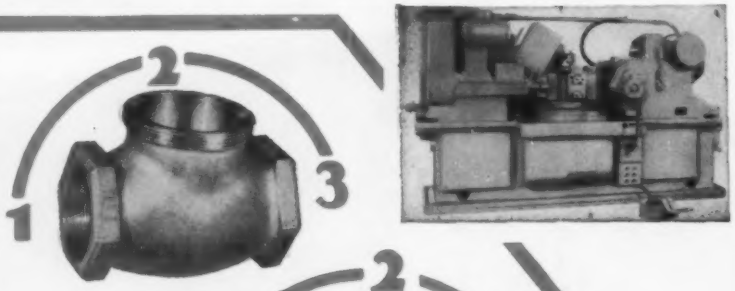


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*perform one to three operations in sequence or simultaneously . . .*

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**More completely finished parts at the end of the day with no partly finished pieces lying around is the regular accomplishment of Goss & De Leeuw "1-2-3" chuckers. It means complete finishing on one, two or three ends simultaneously or in sequence without tool resetting, rechucking or parts handling. Machining operations may include boring, facing, turning and threading.**

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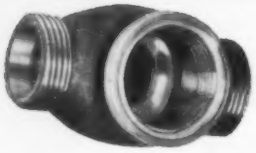

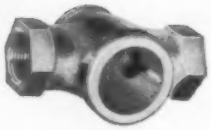

*Investigate the opportunities offered by these machines on your production by sending samples of your work for time and cost estimates—Ask for illustrated descriptive literature.*

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*(Continued on page 286)*

# DON'T LET ESTABLISHED PRACTICES KILL YOUR PRODUCTION POTENTIAL!

The Detroit SCREWMATIC 750 was designed not to lessen or circumvent, but to *overcome*, the recognized shortcomings of ordinary single spindle bar automatic screw machines — basically, their limitations in part-length capacity and spindle speeds.

The result of this new approach to screw machine design? Six infinitely selectable spindle speeds in one cycle, forward or reverse, and a normal part length capacity of more than 10 times maximum spindle capacity!

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Conventional single spindle automatics, limited to part length of about 2 1/2 times spindle capacity, reduce the variety of parts that can be scheduled. But the SCREWMATIC 750 eliminates this limitation, as well as the need for "trick" tooling to produce extra-long shafts with turned, threaded or tapped ends.

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With the cutting tools and metals now available (and often necessary) for many new products, it becomes increasingly important to have a greater selection of spindle speeds. The SCREWMATIC's variable-speed drive motor and instant-reversing transmission make it possible to assign a different speed to six different cutting operations— with speeds in any cycle fully selectable from 50 to 7200 RPM.

Because modern metalcutting demands not only extremely high speeds, but the *correct* speed for specific metals and tools, the infinite spindle speed selection is a *standard* feature of the SCREWMATIC 750—assuring proper cutting speed, plus less downtime because of longer tool life.

**A NEW APPROACH TO PRODUCTION**

With turning speeds and part length no longer limiting factors to volume production, many parts formerly manufactured in multiple automatics, hand screw machines and ordinary lathes are now machined economically, with a minimum of special tooling. Secondary operations and additional parts handling are eliminated, permitting greater latitude for the product engineer.

Progress in production can only be achieved by taking advantage of new machine design. In the SCREWMATIC 750, electronic speed control is one such advancement from the conventional past. Long part length capacity is another achievement.

The Detroit SCREWMATIC 750 has extended the potential for single spindle bar automatics. But there's a great deal more to the story than is told here. We'd welcome the opportunity to tell you how the SCREWMATIC 750 can extend *your* potential beyond the bonds of established practice.

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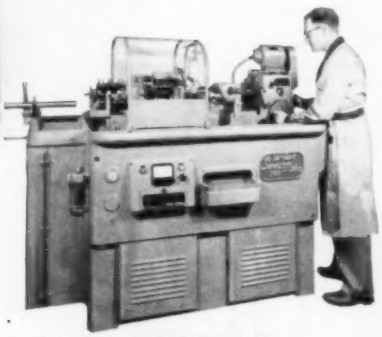
DETROIT Screw Matic 750



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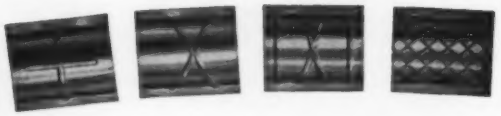
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*(Continued on page 288)*

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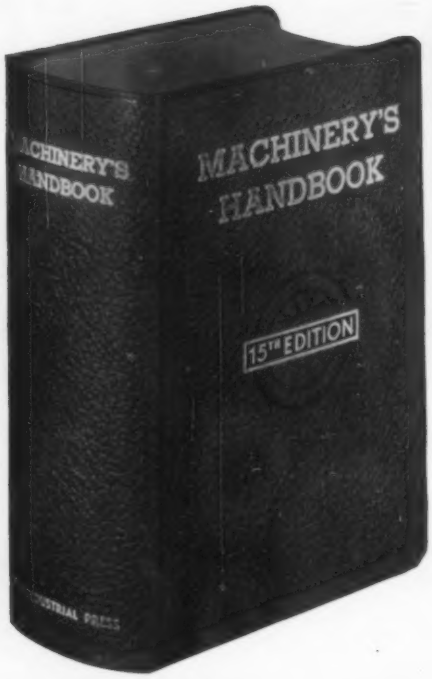


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Coulter, James, Machine Co., Bridgeport 5, Conn.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
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Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
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Federal Machine & Welder Co., Overland Ave., Warren, Ohio
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*(Continued on page 290)*

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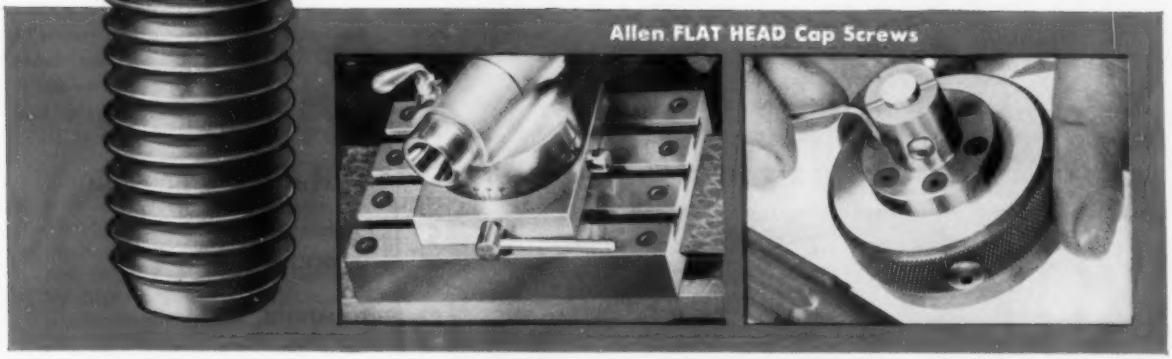


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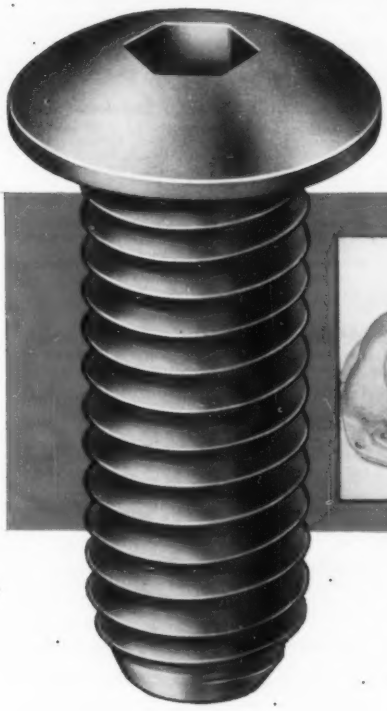

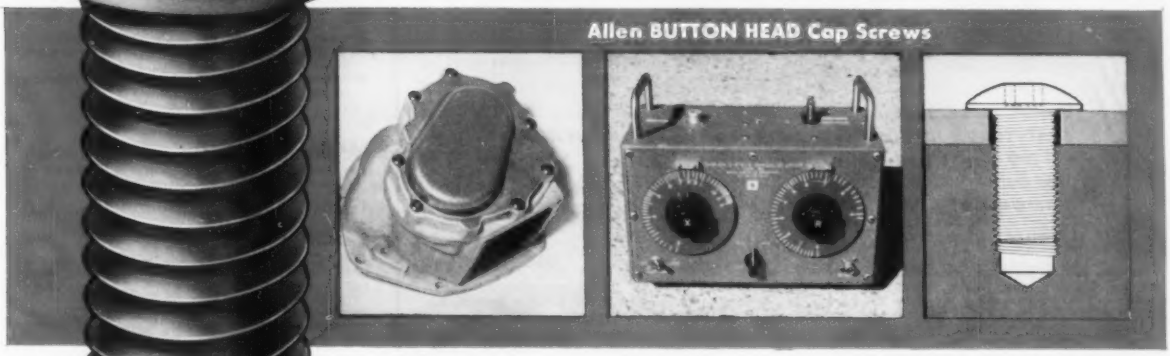


Where you can't countersink—fastening thin metal parts like covers, access panels or guards, for example—Allen Button Head Cap Screws will give you the smooth, streamlined effect you want. Hex-socket wrenching assures a tighter hold—eliminates driver slips, raised metal slivers, and skids that can damage and mar parts and finish. "Pressur-formd," like the Flat Heads above, for far greater strength at vital points. Leader Point. Class 3A fit. No. 4 through ⅝" diameters. Write for FREE samples and full information.

**The cost of Allen Hex-Socket Cap Screws is only a minor fraction of your assembly costs . . . be sure you're getting the timesaving, cost-saving advantages of *genuine* Allens.**

**ALLEN MANUFACTURING COMPANY**
**Hartford 2, Connecticut, U.S.A.**

***Stocked and sold by leading industrial distributors everywhere***

ALLEN HEX-SOCKET SCREWS HEAD

**Ready in September . . . Allen's great new plant!**

Greenlee Bros. & Co., 12th and Columbia Aves., Rockford, Ill.
Hartford Special Mchry. Co., 287 Homestead Ave., Hartford, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio
Kingsbury Mch. Tool Corp., Keene, N. H.
Lake Erie Engrg. Corp., Kenmore Station, Buffalo, N. Y.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Modern Industrial Engrg. Co., 14230 Birwood, Detroit 4, Mich.
Moline Tool Co., 102 20th St., Moline, Ill.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio
National Twist Drill & Tool Co., Rochester, Mich.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
New Jersey Gear & Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Robbins, Omer E. Co., 24800 Plymouth Rd., Detroit, Mich.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Sundstrand Mch. & Tool Co., 2531 11th St., Rockford, Ill.
Universal Engrg. Co., Frankenmuth 2, Mich.
Verson Allsteel Press Co., 93rd St., & S. Kenwood Ave., Chicago, Ill.
Waltham Machine Works, Newton St., Waltham, Mass.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.


VK

USE OUR SKILLS on YOUR LAPPING PROBLEMS

*If that tough production part has Gage Characteristics, try the Van Keuren Precision Lapping Service--*

*. . . a service of special interest to air defense industries*

The Van Keuren Co. laps optical flats to an accuracy of .000001", gage blocks to .000004", plug gages to .000010". Your job may not be this precise, but it's a safe bet that VK skills can save you money on lapping problems involving size, flatness, parallelism or fine surface finish. If that tough production part has at least one gage characteristic, ask for a quotation from VK.

We lap flat and cylindrical work in both metals and non-metals. Sealing rings and plates for pumps and pressure devices, precision pins, spacers, pistons, punches, carbide pivots, valve parts, instrument components and parts for testing inspection equipment, are among the customer items handled economically here in our plant.

If you require lapped or polished surface finishes in the order of .5 to 5.0 RMS, or dimensional tolerances from .000001" to .0001", The Van Keuren Co. can probably help on the problem. The "rule of thumb", as suggested above, is "at least one gage characteristic."

Send for a copy of the new, 258-page Van Keuren Catalog and Handbook No. 36 containing valuable technical and engineering information on measuring problems and methods. Address:

VK 39th YEAR

THE Van Keuren CO.

178 WALTHAM STREET, WATERTOWN, MASS.

Optical Flats . . . Light Wave Equipment . . . Light Wave Micrometers
Gage Blocks . . . Wire Type, Taperlock and Trilock Plug Gages . . . Master Setting Disks . . . Thread Measuring Wires . . . Gear Measuring Wires
Carbide Plug Gages . . . Carbide Pivots . . . Precision Lapping Service

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Boston Gear Works, 320 Main St., North Quincy 71, Mass.
DoAll Co., Des Plaines, Ill.
Horsburgh & Scott Co., 5114 Hamilton, Cleveland, Ohio
James D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
Reliance Electric & Engineering Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

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Bearings, Inc. 3634 Euclid Ave., Cleveland 15, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Automatic Tool Co., S. 7th and N. St., Richmond, Ind.
Standard Electrical Tool Co., 2488-90 River Road, Cincinnati, Ohio

**SPRAYING EQUIPMENT, Metal**
Metallizing Eng. Co., Westbury, L. I., N. Y.

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**STAMPINGS, Sheet Metal**
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Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.

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Bethlehem Steel Co., Bethlehem, Pa.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.
Timken Roller Bearing Co., Canton, Ohio
U. S. Steel Corp., 525 Wm. Penn Pl., Pittsburgh 30, Penna.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

**STEEL DISTRIBUTORS**
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DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Landis Mch. Co., Waynesboro, Pa.
Threadwell Tap & Die Co., Greenfield, Mass.

**STRAIGHTEDGES**—See Machinists' Small Tools

**STRAIGHTENERS, Flat Stock and Wire**
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Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

**STRIP AND SHEET, Ferrous**
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Bethlehem Steel Co., Bethlehem, Pa.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
U. S. Steel Corp., 525 Wm. Penn Pl., Pittsburgh 30, Penna.

**STRIP AND SHEET, Non-ferrous**
American Brass Co., 25 Broadway, New York, N. Y.
Bethlehem Steel Co., Bethlehem, Pa.

*(Continued on page 292)*

# CLIMB MILL with SAFETY

## in either direction . . . to FULL OVERLOAD CAPACITY

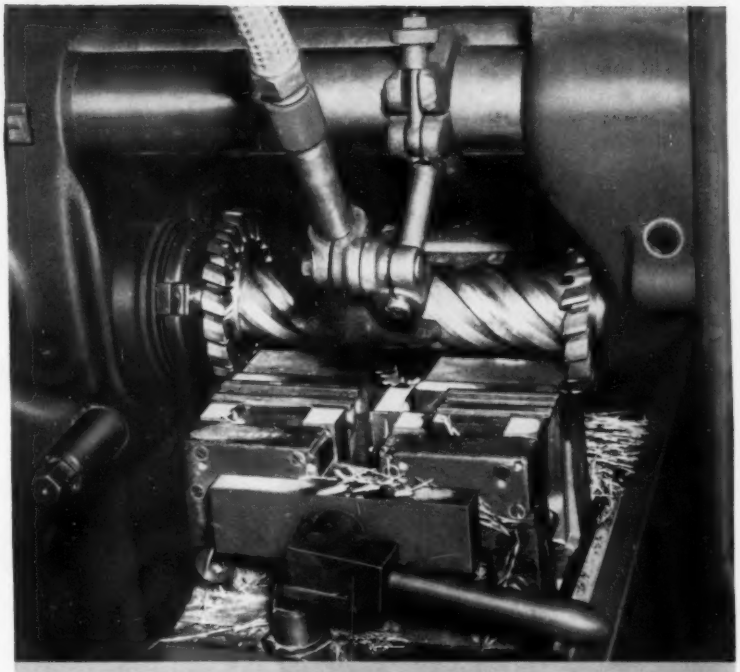
**BROWN & SHARPE**
**No. 12 Plain Milling Machine**
**table drive design**

**ELIMINATES**
**feed screw**
**BACKLASH**

The backlash eliminator mechanism in the No. 12 provides safe and certain control through exclusive features designed by B&S to overcome disadvantages of similar mechanisms. Its operation is simple, and is actuated by the automatic separation of the two members of a double nut, the rotation of which drives the non-rotating table screw longitudinally.

**NO "DRAG" ON TABLE SCREW IN FAST TRAVERSE**

The blacklash eliminator mechanism is released automatically when the table moves at fast travel, — preventing wear, and permitting automatic cycle operation with full efficiency.



***With no backlash problem, you can plan milling set-ups to take full advantage of the extra high cutting loads now practicable with B&S high speed or NELCO carbide cutters.***

**Permits full use of automatic milling cycles**

Since climb milling in either direction is completely practicable, full utilization can be made of the wide variety of time-saving milling cycles provided by the B&S No. 12.

**Permits efficient milling of pieces difficult to hold**

In climb milling, the cutter exerts a downward pressure which seats the work more firmly in the holding device. Thin, narrow, or irregular-shaped pieces can be climb milled without difficulty, in simple fixtures.

With backlash eliminated, you can also take heavier cuts in conventional milling. Cuts can be made at faster feeds without chatter — with no sacrifice of surface quality, and with much longer cutter life.

Compare the all-around performance of the No. 12 with similar production type milling machines. You'll see why the Brown & Sharpe designed backlash eliminator, with many other advantages, makes the No. 12 your best investment . . . for productivity and unlimited adaptability. For complete information, write: Brown & Sharpe Mfg. Co., Providence 1, R. I.

*For extra versatility in production milling cycles*

***SPINDLE POWER FEED ARRANGEMENT**

Permits many milling cycles that require the accurate lowering and raising of the machine spindle in conjunction with table movements.

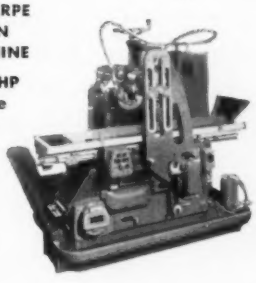
***SPINDLE HEAD RAISING ARRANGEMENT**

Can be set to raise cutter automatically — to prevent marking milled surface during table return — or to clear obstruction between two cuts of same depth.

***OPTIONAL at extra cost**

**BROWN & SHARPE**
**No. 12 PLAIN**
**MILLING MACHINE**

**3, 7½, or 10 HP**
**Spindle Drive**



*PROGRESS IN PRECISION* > *FOR 125 YEARS*

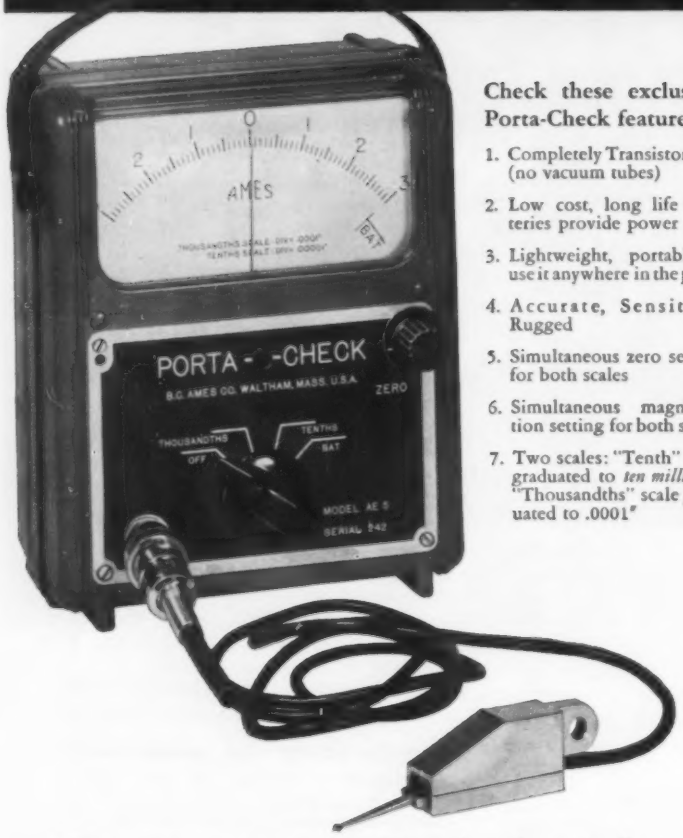
**B&S Brown & Sharpe**

MILLING, GRINDING, AND SCREW MACHINES • MACHINE TOOL ACCESSORIES • PRECISION TOOLS • HYDRAULIC PRODUCTS • CUTTERS

**For more information fill in page number on Inquiry Card, on page 197**

# *Measure in Millionths*

## AMES WITH THE New PORTA-CHECK




**Check these exclusive Porta-Check features**

1. Completely Transistorized (no vacuum tubes)
2. Low cost, long life batteries provide power
3. Lightweight, portable — use it anywhere in the plant
4. Accurate, Sensitive, Rugged
5. Simultaneous zero setting for both scales
6. Simultaneous magnification setting for both scales
7. Two scales: "Tenth" scale graduated to *ten millionths* "Thousandths" scale graduated to .0001"

***Now you can see ten millionths of an inch . . . Easily estimate five millionths with Ames Portable Transistorized Comparator.***

An amazingly sensitive comparator, Ames Porta-Check now makes it possible to get accurate measurements — *in millionths of an inch* — anywhere in the plant. Use it on the production line; at quality control check points; in the tool room — wherever you need it!

The new Ames Porta-Check is truly the most accurate portable comparator available today — and the lowest in cost! See your local Ames representative or write directly to the factory for complete details.

*Representatives in Principal Cities*

**B.C. AMES CO.**

*27 Ames St., Waltham 54, Mass.*

*Canadian Representative — J. B. Morrison Machinery Co., Ltd., 45 Ovide Parkway, Toronto*

MANUFACTURERS OF MICROMETER DIAL INDICATORS AND GAUGES


Bridgeport Brass Co., Bridgeport, Conn.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

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Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
U. S .Steel Corp., 525 Wm. Penn Pl., Pittsburgh 30, Pa.

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DoAll Co., Des Plaines, Ill.

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Allen-Bradley Co., 1331 So. 1st St., Milwaukee, Wis.

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**TAP HOLDERS**
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Cleveland Automatic Mch. Co., 4932 Beech St., Cincinnati 12, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.

**TAPPING HEADS**
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Davis Boring Tool Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y.
Leland-Gifford Co., 1425 Southbridge St., Worcester, Mass.
National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.
Thriftmaster Products Corp., 1076 N. Plum St., Lancaster, Pa.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

**TAPPING MACHINES**
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Baush Machine Tool Co., 15 Wason Ave., Springfield 7, Mass.
Cincinnati Bickford Div. of Giddings & Lewis Mch. Tool Co., Oakley, Cincinnati 9, Ohio
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Edlund Machinery Co., Cortland, N. Y.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Kaufman Manufacturing Co., Manitowac, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
Landis Mch. Co., Waynesboro, Pa.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Moline Tool Co., 102 20th St., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

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Greenfield Tap & Die Corp., Greenfield, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Threadwell Tap & Die Co., Greenfield, Mass.
Winter Bros. Co., Rochester, Mich.

(*Continued on page 294*)

The STANDARD Line:—
Twist Drills
Reamers
Taps . . . Dies
Milling Cutters
End Mills . . .
Counterbores
Carbide Tools
Gages
Hobs

# Stay "On Target" with STANDARD'S Target GUN DRILL*

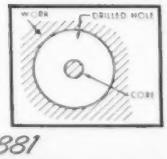
Pat. No. 2418021

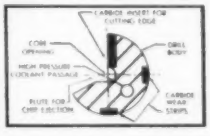
## * . . . Drills Deep or Shallow Holes With Extreme Accuracy . . . Alignment . . . and High Surface Finish!

**THE CORE** . . . Reduces Thrust requirement and minimizes tendency of drill to run.

The detachable design . . . (size 7/16 and larger) allows for easy replacement of carbide heads, an advantage that means less machine down time.

For more detailed information call the STANDARD Man in your area. Take advantage of STANDARD'S Specialized Engineering Service.



PROVEN
Hole 5/16" dia. Length 76" "Accurate one drilling operation"

**TARGET GUN DRILL ADVANTAGES:**

- Eliminates zero surface speed at center.
- Rigid, sturdy shank . . . Starts straight. Stays straight.
- Accurate diameters and alignment. Can often eliminate reaming operations.

The STANDARD Distributor in your area stocks a complete line of rotary metal cutting tools.

*Quality Tools Since 1881*

# STANDARD TOOL CO.

STANDARD TOOL CO.

3950 CHESTER AVENUE CLEVELAND 14, OHIO

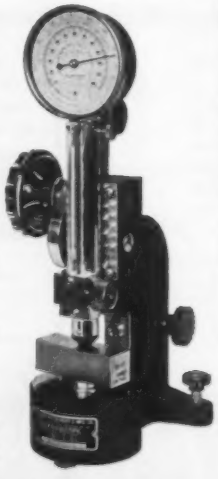
BRANCH WAREHOUSES IN: NEW YORK · DETROIT · CHICAGO · DALLAS · LOS ANGELES · SAN FRANCISCO

For more information fill in page number on Inquiry Card, on page 197

# "SHORE for SURE"

## HARDNESS TESTING

Shore's Improved Direct Reading Scleroscope (above) and Standard Recording Scleroscope (below) with dial graduated in standard Scleroscope and equivalent Brinell and Rockwell "C" Hardness Numbers, are able to perform over 1000 hardness tests per hour. Both Scleroscopes are completely portable, operative on all types and sizes of metals, are reliable in hands of non-technical help, and show no visible injury signs on finished surfaces. Write for free brochures on these instruments.



Direct Reading Scleroscope shown above with special Swing Arm & Post Assembly. Height capacity 9", reach 14". To be mounted on bench for testing large objects. Supplied with two test blocks and diamond hammer.

Standard Recording Scleroscope (right) with Clamping Stand, jaw capacity 3" high x 2⅛" deep. Supplied with following accessories: diamond hammer, hard and soft test block, V block for testing rounds, and steel carrying case.

THE SHORE INSTRUMENT and MANUFACTURING Co., Inc.
90-35 Van Wyck Expressway, Jamaica 35, N. Y.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Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
Sheffield Corp., Box 893, Dayton 1, Ohio

**THREAD CUTTING MACHINES**
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Errington Mach. Lab. Inc., 24 Norwood Ave., Staten Island 4, N. Y.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., Box 893, Dayton 1, Ohio

**THREAD CUTTING TOOLS**
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Geometric Tool Co. Div., Greenfield Tap & Die Corp., New Haven 15, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., Box 893, Dayton 1, Ohio

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**THREAD ROLLING EQUIPMENT**
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Landis Machine Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
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**TIME RECORDERS**
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Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Cleveland Automatic Mch. Co., 4932 Beech St., Cincinnati 12, Ohio
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio
R & L Tools, 1825 Bristol St., Philadelphia 40, Pa.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

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Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Vascoloy-Ramet Corp., Waukegan, Ill.

**TOOL MATERIAL, Cemented Carbide**
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Apex Tool & Cutter Co., Inc., Shelton, Conn.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 30, Ill.
Cleveland Twist Drill Co., 5214 W. Armstrong, Cleveland, Ohio
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Metal Carbides Corp., Youngstown 12, Ohio
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

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Metal Carbides Corp., Youngstown 12, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Vascoloy-Ramet Corp., Waukegan, Ill.

**TOOL MATERIAL, High-Speed Steel**
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Apex Tool & Cutter Co., Inc., Shelton, Conn.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 30, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio

**TRACING ATTACHMENTS**
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Atlas Press Co., Kalamazoo, Mich.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
Wales-Strippit Co., Akron, N. Y.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio

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**TRANSMISSION, Variable Speed**
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Boston Gear Wks., Quincy, Mass.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Reliance Electric & Engineering Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio
Vickers, Inc., Detroit 32, Mich.

**TRUCKS, Material Handling**
Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio

**TUBE-FLANGING MACHINES**
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**TUBE FORMING AND WELDING MACHINES**
Yoder Co., 5504 Walworth Ave., Cleveland, Ohio

**TUBE MILLS**
Yoder Co., 5504 Walworth Ave., Cleveland, Ohio

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Mueller Brass Co., Port Huron 34, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 18, Ill.

**TUBING, Steel**
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Babcock & Wilcox Co., Beaver Falls, Pa.
National Tube Div., U. S. Steel Corp., 525 Wm. Penn Place, Pittsburgh, Pa.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 18, Ill.
Timken Roller Bearing Co., Canton, Ohio

**TUBE & PIPE CUTTING-OFF MACHINES**
Sheffield Corp., Box 893, Dayton 1, Ohio

*(Continued on page 296)*

# MRC

## Super-Precision BALL BEARINGS

M-R-C Super-Precision Ball Bearings are made to such a high degree of accuracy that they are literally "out of this world."

The same qualities that are required in M-R-C Bearings used in guidance systems of today's missiles are necessary for the successful performance of modern high-speed machine tools.

M-R-C Super-Precision Ball Bearings are currently being used in the development of the machine tools needed to produce the extremely precise equipment required to conquer outer space.

*Let OUR Engineering Department help solve YOUR bearing problems.*

MRC
BALL AND ROLLER *bearings*

**MARLIN-ROCKWELL CORPORATION**
Executive Offices: **Jamestown, N.Y.**

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Vickers, Inc., Detroit 32, Mich.

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Hydraulic Press Mfg. Div., Mt. Gilead, Ohio
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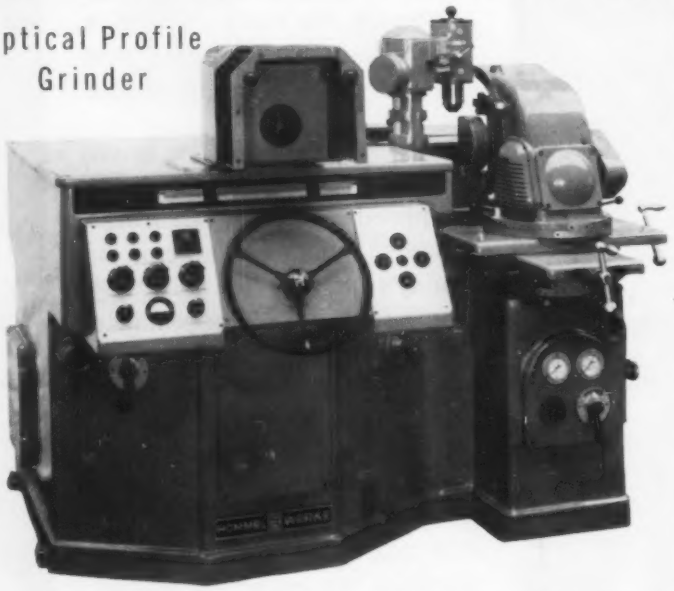

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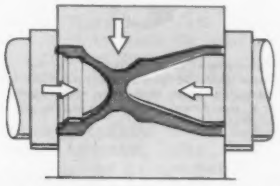

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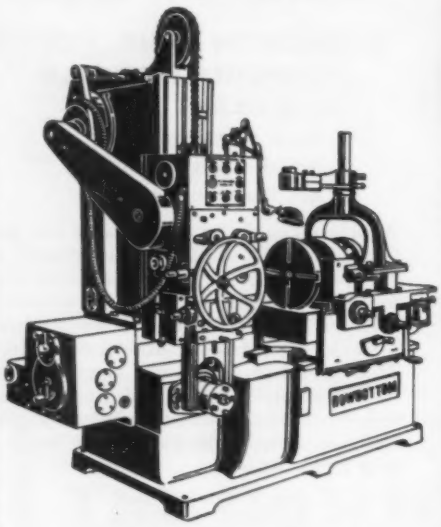

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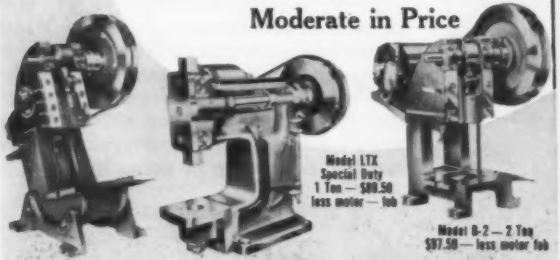

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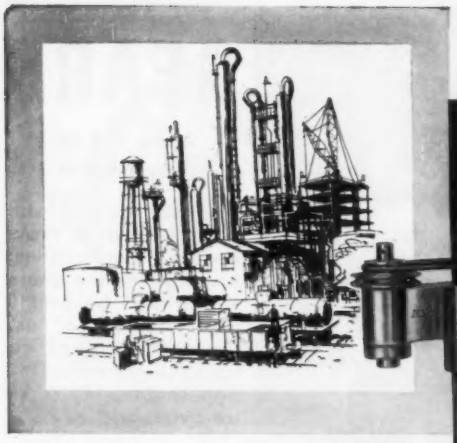

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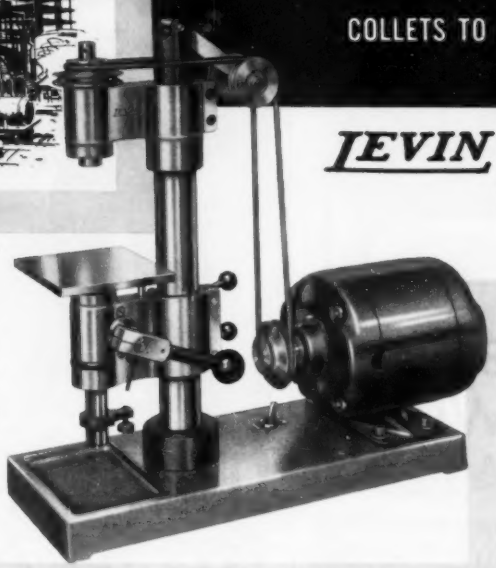

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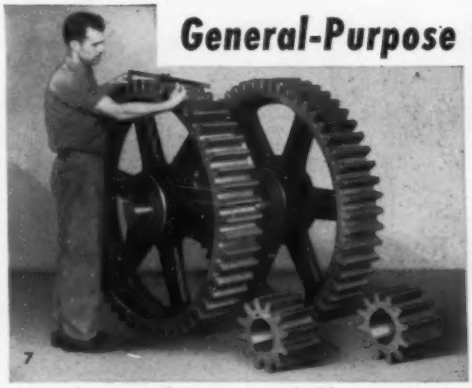

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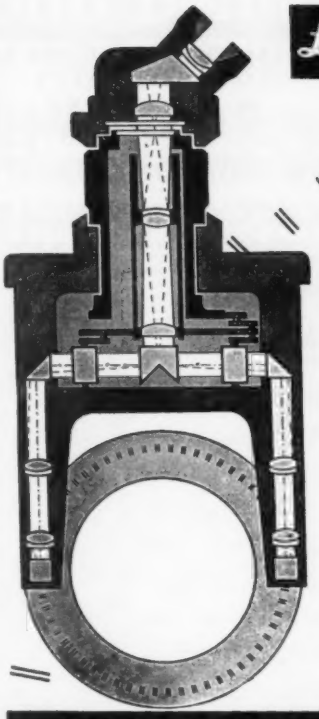

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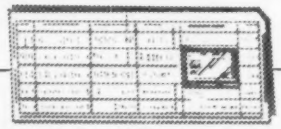

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18" National Broach Red Ring Gear Lapper, m.d., late

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AUTOMATIC. 2" RB6 Acme Gridley, 1945
AUTOMATIC. 5" 4 spdl. Conomatic, barfeed, 1944
BORING MILL. 3¾" bar No. 5 Dehaney, 1942
BORING MILL 4" bar Universal "Tri-Way", 1000 rpm Timken brg., nitralloy bar
BROACH. 10 ton 54" stroke American duplex, vert. 1941
COMPRESSOR. 455 CFM Ingersoll Rand duplex synchr.
COMPRESSOR. 3865 CFM Worthington duplex 650 HP. Synchr. motor on shaft
DRILL, SENS. 25" MA6 Avey. No. 2 MT, 1945
GEAR HOBBER. Type A Barber Colman, 1944
GEAR SHAPER. 7125A Fellows, 1942
GEAR SHAVER. GCC Red Ring, 8". late
GRINDER, UNIV. 14" x 14" Rivett Model 112, 1942
GRINDER, PLAIN. 20" x 72" Landis, 1943
GRINDER, DISC. 30" No. 84A Gardner opposed
GRINDER, INT. 72A5 Heald Univ. 1943
GRINDERS, SURF. 36" No. 18 Blanchard, 1940
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LATHE. 126" x 96 ft. Niles Bement Pond.
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MILL. No. 33 Sandstrand auto. "Fluidscrew", 1943
MILL. No. Brown & Sharpe vert., 1943
MILL. No. 36 Van Norman
OIL GROVER. Wicaco continuous, 1953
SAW. 10" x 10" Racine "Shearcut", hack, 1941
SHAPER-PLANER. 36" Rockford anv. openside.
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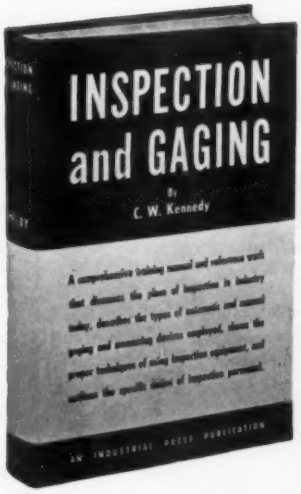


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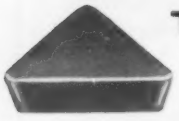

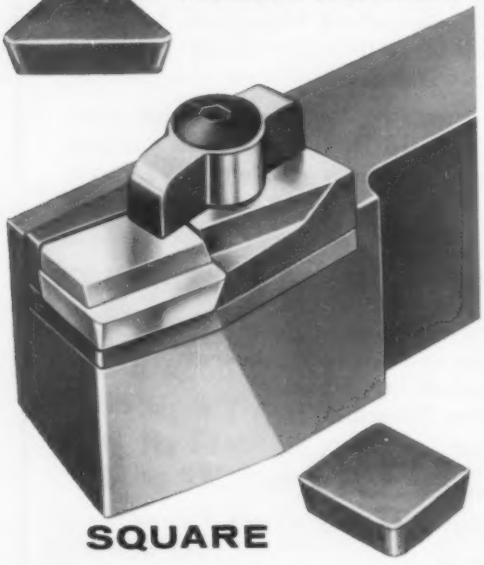

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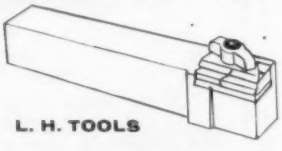

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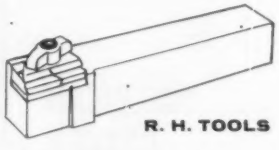

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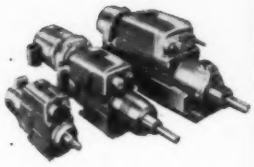

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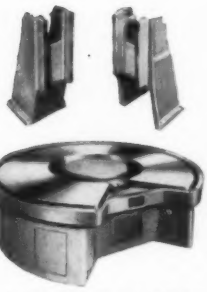

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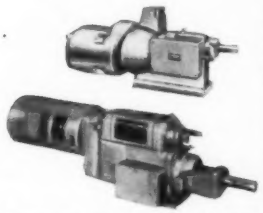

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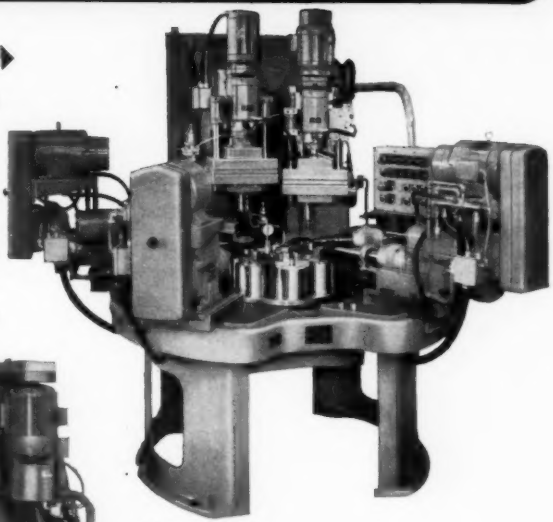
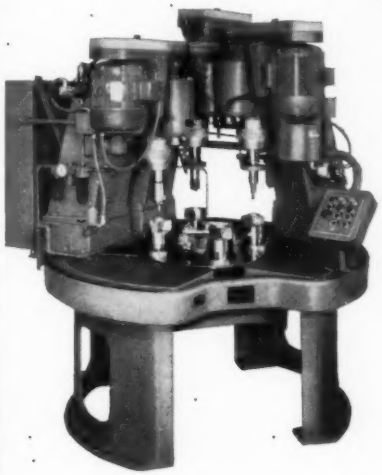
Rectangular Machine Base

**EXAMPLE*** ▶

**A high speed indexing machine to drill and lead screw tap horizontal opposed pipe ports and two vertical mounting holes in stainless steel valve bodies at 320 parts per hour. Standard automatic self-centering Skinner air chucks hold parts.**

Photo courtesy of The Skinner Chuck Company

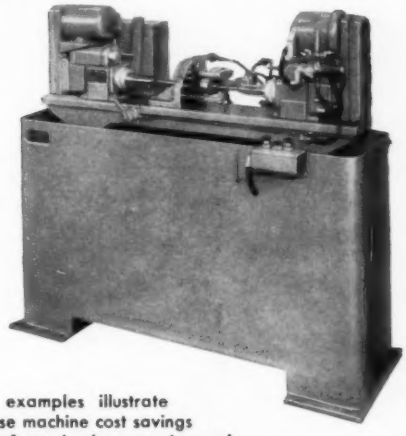




◀ **EXAMPLE***

**Combination drill, bore and face plus two tapping operations in die cast regulator valve spring cages. Capacity: 450 parts per hour.**

Photo courtesy of Watts Regulator Company



**EXAMPLE*** ▶

**Double end opposed combination ream and face die cast piston plates to close tolerance. Simplified air-manual fixture loading permits production of 423 parts per hour.**

Photo courtesy of Bendix Products Division Bendix Aviation Corporation

***Note**

**The above examples illustrate single-purpose machine cost savings through use of standard pre-engineered components. The components, bases, columns, adapters and units as shown, are available for machines built by you or for you from Hartford Special.**

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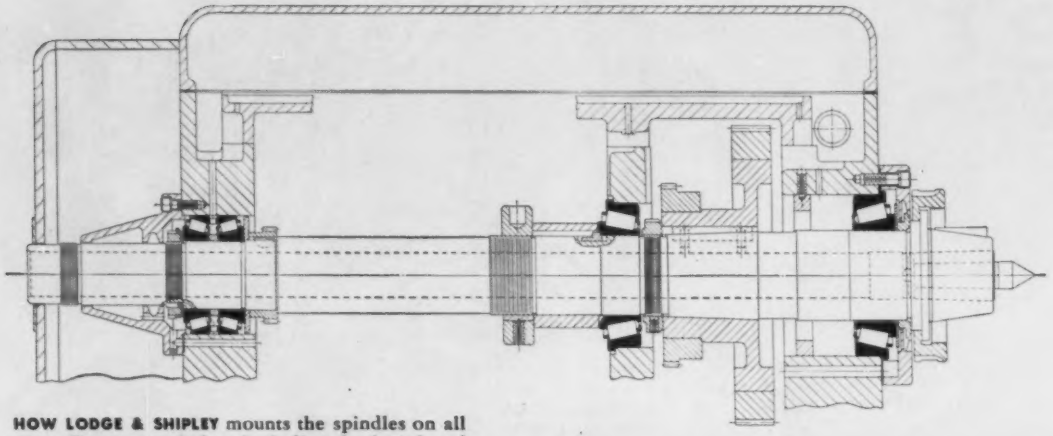

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